

Guidance Manual for Total Maximum Daily Load Implementation Plans

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***The Commonwealth of Virginia:
Department of Conservation and Recreation
Department of Environmental Quality***

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List of Abbreviations Used in the Manual

BMP - Best Management Practice
BST - Bacterial Source Tracking
CPP - Continuing Planning Process
CREP - USDA Conservation Reserve Enhancement Program
CWA - Clean Water Act
EPA - United States Environmental Protection Agency
ESC - Erosion and Sediment Control
FC - Fecal coliform
FSA - Farm Service Agency
FTE - Full time equivalent
GIS - Geographic Information System
GWLF - Generalized Watershed Loading Functions
HSPF - Hydrologic Simulation Programs in Fortran
IP - Implementation Plan
LA - Load Allocation
MS4 – Municipal Separate Storm Sewer System
NAPP- National Aerial Photography Program
NPDES – National Pollutant Discharge Elimination System
NPS - Nonpoint source
NRCS - Natural Resources Conservation Service
PDCs - Planning District Commissions
PS - Point source
SWAP - Source Water Assessment Program
SWCD - Soil and Water Conservation District
SWM - Storm Water Management
SWMM - Storm Water Management Model
TMDL - Total Maximum Daily Load
UAA - Use Attainability Analysis
USDA - United States Department of Agriculture
USGS - U.S. Geological Survey
USLE - Universal Soil Loss Equation
DCR - Virginia Department of Conservation and Recreation
DEQ - Virginia Department of Environmental Quality
DOF - Virginia Department of Forestry
VCE - Virginia Cooperative Extension
VDACS - Virginia Department of Agriculture and Consumer Services
VDH - Virginia Department of Health
VPDES - Virginia Pollutant Discharge Elimination System
WLA - Waste load allocation
WQMIRA - Water Quality Monitoring, Information, and Restoration Act
WQMPs - Water Quality Management Plans
WWTP - Wastewater treatment plant

Introductory Statement

This manual provides guidance to local governments, soil and water conservation districts, planning district or regional commissions, community watershed groups, and state and federal agencies on developing Implementation Plans (IPs) for waters where TMDLs have been completed. It also addresses the requirements for IPs as outlined in Virginia's 1997 Water Quality Monitoring, Information, and Restoration Act (§62.1-44.19:4 through 19:8 of the Code of Virginia), or WQMIRA. In addition to the requirements of WQMIRA, this guidance manual addresses the requirements of IPs based on EPA's "*Guidance for Water-Quality Based Decisions: The TMDL Process*," "*Supplemental Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories*," and "*Guidance for Developing Watershed-Based Plans for Impaired Waters*."

This manual also outlines both the recommended and required components of an IP. These elements are listed on page 2. Information pertaining to state and federal guidance for IPs is presented in Chapter 3.

An IP is prepared at some point following development of the TMDL, and approval by EPA. The TMDL represents the maximum amount of pollutant that a water body (stream, lake, or estuary) can receive without exceeding water quality standards. TMDLs are pollutant-specific so that each water body in which multiple pollutants violate water quality standards will have multiple TMDLs. The TMDL consists of a waste load allocation (WLA) or point source contribution; a load allocation (LA) or nonpoint source (NPS) allocation; and a margin of safety (MOS). IPs are not necessarily pollutant-specific and should be designed to address multiple water quality problems within a water body or all water quality-impaired water bodies within a watershed.

Section 303(d) of the Clean Water Act and the EPA's Water Quality Planning and Management Regulation (40 CFR Part 130) require states to develop TMDLs for water bodies that are exceeding water quality standards. Once the TMDL has been developed, a TMDL report is prepared and distributed for public comment and then submitted to EPA for approval. Following this process, an IP should be developed to describe actions (*i.e.*, best management practices) to implement the allocations contained in the TMDL. In most cases, the WLAs would be addressed through the Virginia Pollutant Discharge Elimination System (VPDES) Program administered by the Virginia Department of Environmental Quality.

Revisions of this manual may be necessary due to statutory or regulatory changes. As changes occur, periodic additions or supplements will be prepared for inclusion into the manual. This manual and future revisions are available on the DEQ web site at <http://www.deq.state.va.us/tmdl> and the DCR web site at <http://www.dcr.state.va.us/>

ACKNOWLEDGEMENTS

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Components of a TMDL Implementation Plan

1.0 EXECUTIVE SUMMARY

The Executive Summary chapter of the IP is a summation of the entire implementation plan process. The Executive Summary should include a section for each of the chapters in the IP, with a brief summary of each chapter following. Because of this, it cannot be written until the IP has been completed.

The chapter should first provide information from the **Introduction** of the IP, such as background on why a TMDL was conducted for the water body, including specifics on the dates, the type(s) of impairment(s), and the water quality standard that was being violated. It should include a goal for the IP such as “This plan was developed with the goal of achieving the reductions stated in the TMDL report and restoring these waters to a fully supporting status.”

The Executive Summary chapter should include a paragraph summarizing the **Review of the TMDL Development**. This paragraph can include the agencies/companies involved in the development of the TMDL, the loads and transport mechanisms considered in modeling, and the required reductions from the TMDL report.

The Executive Summary should also include a section summarizing the **Public Participation** involved in the development of the IP. This section should recognize the citizens and agencies that provided input for the IP. Also, this section should briefly describe the intent of any public meetings, focus groups, steering meetings, websites, the media, or mailings used in the development of the IP.

A brief summary of **Implementation Actions** should be included in this chapter. This summary can include a description of water quality monitoring that was performed throughout the course of the IP development, the assessment of needs determined during the development of the IP, and the costs and benefits analysis of implementation.

The Executive Summary should have a section describing the **Measurable Goals and Milestones** of the IP. The lead agencies agreeing to be responsible for overseeing implementation should be identified, as well as the milestones and goals set for implementation. A brief discussion of targeting efforts should also be included in this section.

Finally, this chapter should mention the **Stakeholders’ Roles and Responsibilities**, the **Integration with Other Watershed Plans**, if any, and **Potential Funding Sources**.

Components of a TMDL Implementation Plan:

1. **Executive Summary**
2. Introduction
3. State and Federal Requirements for Implementation Plans
4. Review of TMDL Development
5. Public Participation
6. Implementation Actions
7. Measurable Goals and Milestones
8. Stakeholders’ Roles and Responsibilities
9. Integration with Other Watershed Plans
10. Potential Funding Sources

2.0 INTRODUCTION

*(The language and/or regulatory references included in this section may be inserted into the **Introduction** chapter of the IP.)*

The Clean Water Act (CWA) that became law in 1972 requires that all U.S. streams, rivers, and lakes meet certain water quality standards. The CWA also requires that states conduct monitoring to identify polluted waters or those that do not meet standards. Through this required program, the state of Virginia has found that many stream segments do not meet state water quality standards for protection of the five beneficial uses, which are fishing, swimming, shellfish, aquatic life, and drinking.

The INTRODUCTION of the Implementation Plan should clearly indicate the:

- topic of the IP;
- purpose of the IP;
- IP contents, including information on scope.

The INTRODUCTION should also address the following questions:

- What is the impairment?
- What is the pollutant or cause of the impairment?
- What is the extent of the impaired segment?
- What is the extent of the watershed (*i.e.*, watershed boundary)?
- What are the designated uses of the water body?
- What are the applicable water quality standards?

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When streams fail to meet standards, Section 303(d) of the CWA and the US Environmental Protection Agency's (EPA) Water Quality Management and Planning Regulation (40 CFR Part 130) requires states to develop TMDLs for each pollutant. A TMDL is a "pollution budget" for a stream. That is, it sets limits on the amount of pollution that a stream can tolerate and still maintain water quality standards. In order to develop a TMDL, background concentrations, point source loadings, and non-point source loadings are considered. A TMDL accounts for seasonal variations and must include a margin of safety. Through the TMDL process, states establish water-quality based controls to reduce pollution and meet water quality standards.

Once a TMDL is developed and approved by EPA, measures must be taken to reduce pollution levels in the stream. These measures, which can include the use of better treatment

technology and the installation of best management practices (BMPs), are implemented in a staged process that is described along with specific BMPs in the IP.

In general, the Commonwealth intends for the pollutant reductions to be implemented in a staged fashion. Staged implementation is an iterative process that first addresses those sources with the largest impact on water quality. For example, a promising management practice in agricultural areas of an impaired watershed is livestock exclusion from streams. This has been shown to be very effective in lowering bacteria concentrations in streams, both from the cattle deposits themselves and from additional buffering in the riparian zone. Additionally, reducing the human bacteria loading from failing

septic systems and straight pipes should be a focus during the first stage because of its health implications.

There are many benefits of staged implementation, including:

1. as stream monitoring continues to occur, it allows for water quality improvements to be recorded as they are being achieved;
2. it provides a measure of quality control, given the uncertainties which exist in any model;
3. it provides a mechanism for developing public support;
4. it helps to ensure the most cost effective practices are implemented initially; and
5. it allows for the evaluation of the adequacy of the TMDL in achieving the water quality standard.

With successful completion of IPs, Virginia will be well on the way to restoring impaired waters and enhancing the value of this important resource. Additionally, development of an approved IP will improve a locality's chances for obtaining monetary assistance during implementation.

3.0 STATE AND FEDERAL REQUIREMENTS FOR IMPLEMENTATION PLANS

*(The language and/or regulatory references included in this section may be inserted into the **State and Federal Requirements for Implementation Plans** chapter.)*

There are a number of state and federal requirements and recommendations for TMDL IPs. The goal of this chapter is to clearly define these and explicitly state if the "elements" are a required component of an approvable IP or are merely a recommended topic that should be covered in a thorough IP. This chapter has three sections that discuss the a) requirements outlined by the Water Quality Monitoring, Information, and Restoration Act (WQMIRA) that must be met in order to produce an IP that is acceptable and approvable by the Commonwealth, b) EPA recommended elements of IPs, and c) required components of an IP in accordance to Section 319 guidance.

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3.1 State Requirements

The TMDL IP is a requirement of Virginia's 1997 Water Quality Monitoring, Information, and Restoration Act (§62.1-44.19:4 through 19:8 of the Code of Virginia), or WQMIRA. WQMIRA directs Virginia Department of Environmental Quality (DEQ) to "develop and implement a plan to achieve fully supporting status for impaired waters." In order for IPs to be approved by the Commonwealth, they must meet the requirements as outlined by WQMIRA.

WQMIRA requires that IPs include the following:

- date of expected achievement of water quality objectives;
- measurable goals;
- necessary corrective actions;
- associated costs, benefits, and environmental impact of addressing the impairment.

IPs **must** include these four elements in order to meet the requirements of WQMIRA.

3.2 Federal Recommendations

Section 303(d) of the CWA and current EPA regulations do not require the development of implementation strategies. EPA does, however, outline the minimum elements of an approvable IP in its 1999 "Guidance for Water Quality-Based Decisions: The TMDL Process". The listed elements include

- a description of the implementation actions and management measures,
- a time line for implementing these measures,
- legal or regulatory controls,
- the time required to attain water quality standards, and
- a monitoring plan and milestones for attaining water quality standards.

It is strongly suggested that the EPA recommendations be addressed in the IP (in addition to the required components as described by WQMIRA).

3.3 Requirements for Section 319 Fund Eligibility

EPA develops guidelines that describe the process and criteria to be used to award CWA Section 319 nonpoint source grants to States. The guidance is subject to revision and the most recent version should be considered for IP development. The “Supplemental Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories in FY 2003” identifies the following nine elements that must be included in the IP to meet the 319 requirements:

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| <ol style="list-style-type: none">1. Identify the causes and sources of groups of similar sources that will need to be controlled to achieve the load reductions estimated in the watershed-based plan;2. Estimate the load reductions expected to achieve water quality standards;3. Describe the NPS management measures that will need to be implemented to achieve the identified load reductions;4. Estimate the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement the watershed-based plan.5. Provide an information/education component that will be used to enhance public understanding of the project and encourage the public’s participation in selecting, designing, and implementing NPS management measures;6. Provide a schedule for implementing the NPS management measures identified in the watershed-based plan;7. Describe interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented;8. Identify a set of criteria for determining if loading reductions are being achieved and progress is being made towards attaining water quality standards, and if not, the criteria for determining if the watershed-based plan needs to be revised; and9. Establish a monitoring component to evaluate the effectiveness of the implementation efforts. | <hr/> <p>Congress amended the Clean Water Act (CWA) in 1987 to establish the Section 319 Nonpoint Source Management Program. Under Section 319, State, Territories, and Indian Tribes receive grant money, which supports a wide variety of activities, including the restoration of impaired waters.</p> <hr/> |
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For more information on the requirements for Section 319-fund eligibility, refer to <http://www.epa.gov/owow/nps/cwact.html> or <http://www.dcr.state.va.us/sw/ss319.htm>.

4.0 REVIEW OF TMDL DEVELOPMENT

In order to set the stage for implementation, it is necessary to include a summary of the results of the TMDL development. This section of the IP should, therefore, describe the impairment(s), watershed characteristics, results of the TMDL study, and load reductions required to restore water quality. These are all components that can be found in the approved TMDL report.

In the REVIEW OF TMDL DEVELOPMENT chapter, the following should be included:

- description of impairment(s);
- description of watershed characteristics, including land use and watershed maps;
- description of water quality monitoring;
- description of water quality modeling;
- description of sources of pollutant considered;
- allocation results and load reductions required to restore water quality

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4.1 Description of Impairment(s)

TMDLs are established for impairments or threats to a water body caused by identifiable pollutants, as defined by the CWA (EPA, 1999). In Virginia, TMDLs are developed when specific physical, chemical, biological or radiological water quality values (*e.g.*, pH, dissolved oxygen, bacteria, tributyltin, nutrients) violate a numeric limit or when fish tissue screening levels are the primary cause of impairment (*e.g.*, Virginia Department of Health (VDH) Health Advisory (Mercury), VDH Health Advisory (PCBs)).

Bacteria impairments are currently identified by determining values of fecal coliform or *E. coli*. A TMDL document developed for a bacterial impairment may be titled by type of bacteria measured (*e.g.*, “Fecal Coliform TMDL Development for Middle Blackwater River, Virginia”). Bacteria impairments of shellfish waters are determined using more restrictive water quality standards than other bacteria impairments. A TMDL study of shellfish waters with a bacterial impairment is often referred to as a “Shellfish TMDL.”

A TMDL developed for a general standard (benthic) impairment addresses one or more specific pollutant(s) that have been shown to impact the health of the aquatic communities.

In some cases, several TMDLs have been developed for the same water body, each addressing a different impairment (*e.g.*, bacteria and benthics). A single IP may address these multiple TMDLs for the same impaired water body. This would require that information from all TMDL reports be incorporated into the IP.

Additionally, a water body may be listed in the 303(d) list for other impairments. If the IP does not specifically address all impairments for the water body, it is important to consider potential implementation actions with regard to their impacts on all known impairments of the water body, so that implementation can be more efficient.

4.2 Description of Watershed Characteristics

If available, some watershed characteristics that can be included in the Review of TMDL Development chapter are drainage area, location (counties, cities, towns), if the study area is part of a larger watershed, confluences, headwaters, and land use. Maps of the watershed should be included which show the location of the watershed, subwatersheds used in the TMDL study, and the land uses for the watershed.

An understanding of the watershed characteristics, particularly a description of land use, is necessary when choosing implementation actions. The three general categories of land use that are most commonly used are agricultural, urban, and forest. The approved TMDL report will sometimes provide information on land use in percentages. For example, “The Middle Blackwater Watershed is approximately 23,206 acres comprised of forest (54.6%), agricultural (38%), and urban (7.4%) land uses.” (“Fecal Coliform TMDL development for Middle Blackwater River, Virginia, 2000”) At times, the TMDL report will have more detailed land use descriptions provided by sources such as Virginia Department of Conservation and Recreation (DCR).

4.3 Description of Water Quality Monitoring

When considering the water quality monitoring conducted in support of the TMDL, it is important to assess any monitoring conducted specifically as a part of the TMDL development as well as any historical monitoring efforts that have been documented. Monitoring efforts may include ambient water quality monitoring (*e.g.*, temperature, dissolved oxygen, pH, bacteria, nutrients) conducted by DEQ, special studies conducted by DEQ, research monitoring conducted by academic institutions, voluntary monitoring conducted by citizens or local government entities, or some combination of all the above. Depending on the intensity of previous and current monitoring efforts, it may be possible to use the resultant data to help in targeting implementation strategies.

4.3.1 Temporal Monitoring

Temporal monitoring includes in-stream monitoring at stations within the impaired watersheds, typically located at the watershed outlet, conducted on a fixed-frequency basis (*e.g.*, monthly, bimonthly, quarterly, or semi-annually). For example, a general standard (benthic) TMDL is developed using ambient data monitored on a semi-annual basis, while a bacterial (fecal coliform) TMDL may have been developed using monthly, bimonthly, and/or quarterly data. This type of data is useful in establishing the level of impairment but is typically not adequate to ascertain the spatial and temporal variability of the impairment needed to aid in targeting. Voluntary citizen monitoring may have been assessed for use in the TMDL development as well. While voluntary monitoring may not meet quality assurance requirements for listing (or de-listing) a stream segment as impaired, it may be useful in improving the overall picture of the impairment, depending on the distribution of monitoring sites and frequency of sampling.

In the case of bacteria impairments, any bacteria source tracking (BST) data should be included. Such data will add to the overall picture of the impairment and is geared towards establishing the nature of the impairment.

Bacterial source tracking (BST) is intended to aid in identifying sources (*e.g.*, human, livestock, or wildlife) of fecal contamination in water bodies. The information gained provides insight into the likely sources of fecal contamination, and will improve the chances for success in implementing solutions.

4.3.2 Spatial and Temporal Monitoring

Spatial and temporal monitoring includes water quality data collected at the outlets of impaired watersheds in addition to water quality data collected at various points within the watershed on a fixed-frequency and/or storm-event basis. Data collected from a spatially distributed monitoring network can be useful in identifying and targeting implementation strategies, as this data can be used to identify “hot spots” (subwatersheds where initial implementation resources would result in the greatest return in water quality improvement) that, if targeted for implementation actions early in the implementation process, may produce significant results in terms of reaching water quality goals. For example, for a bacterial impairment in an urban area, data collected from a spatially distributed monitoring network could more specifically identify pollutants from leaking sewer lines or urban wash-off from parking lots than what is provided with temporal monitoring. This type of monitoring is generally supported through special studies or locally funded monitoring programs.

4.4 Description of Water Quality Modeling

In order to understand the implications of the load allocations determined during the TMDL development, it is important to understand the modeling methods used in the analysis. Modeling used in the development of TMDLs varies from *simple* to *mid-range* to *detailed*. The Compendium of Tools for Watershed Assessment and TMDL Development (EPA, 1997) provides an overview of a variety of techniques and models used in TMDL development.

A TMDL developed with a simple modeling effort might be based solely on an analysis of monitored data (such as instream water quality data collected at the outlet of the impaired watershed) or may make use of data to determine some basic relationships (e.g., pollutant responses to high flows vs. low flows). With simple modeling efforts, very little can be done to predict the impact of different stages of implementation or different targeting scenarios. Use of a load duration curve to estimate the impacts of directly deposited sources of bacteria as compared to land-based sources falls into this category.

SIMPLE MODELING:

- relies on generalized sources of information
- uses simple mathematical relationship between physiographic characteristics of the watershed and pollutant export
- uses large simulation time steps to provide long-term averages or annual estimates

MID-RANGE MODELING:

- relies on site-specific data
- uses a management-level approach to assess pollutant sources and transport
- uses small time steps to represent temporal variability
- relates pollutant loadings to hydrologic and erosion processes

DETAILED MODELING:

- relies on intensive data collection within the watershed
- uses algorithms to simulate the physical processes of infiltration, runoff, pollution accumulation, instream effects, and groundwater/surface water interaction
- uses small time steps to allow for continuous and storm event simulations
- provides accurate estimations of pollutant loads and the expected impacts on water quality

Source: Compendium of Tools for Watershed Assessment and TMDL Development (EPA, 1997)

Mid-range modeling might include the use of monthly or annual loading models, such as Generalized Watershed Loading Functions (GWLF) or the Universal Soil Loss Equation (USLE). (For more information on these techniques, refer to the Compendium of Tools for Watershed Assessment and TMDL Development (EPA, 1997).) These mid-range models can be used during IP development to gauge the relative water quality impacts of different stages of implementation, but they provide a summarized picture of the responses and typically lack the spatial refinement needed for modeling scenarios for targeted sites.

A detailed model (*e.g.*, Hydrologic Simulation Program-FORTRAN – HSPF, or Storm Water Management Model – SWMM) will take into account temporal and spatial variations in the nonpoint pollution loads. These detailed models can be used to predict the water quality impacts of different stages of implementation, as well as various scenarios for targeted sites.

4.5 Description of Sources Considered

Potential sources of the pollutant considered in the development of the TMDL include both point source and NPS contributions.

4.5.1 Point Sources

Point sources are pollutant loads discharged at a specific location. These can be pipes, outfalls, and conveyance channels from either municipal wastewater treatment plants or industrial waste treatment facilities. Any person who discharges or proposes to discharge any pollutant into surface waters of the Commonwealth from a point source must apply for a Virginia Pollutant Discharge Elimination System (VPDES) permit. The VPDES permit program classifies dischargers based on type of discharge and volume:

Major: sewage with a design volume equal to or greater than 1.0 million gallons per day and industrial discharges requiring EPA review.

Minor: commercial, small industrial and sewage of less than 1.0 million gallons per day.

General: typically small volumes of low potency pollutants.



The TMDL's WLA accounts for the portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. In most cases, all point sources of pollution located in the specified watershed must be accounted for in the WLA portion of the TMDL.

Once the TMDL has been developed by the Commonwealth and approved by EPA, the effluent limitations for each permit (*i.e.*, point source) identified in the report must be consistent with the assumptions and requirements of any available WLA for the discharge (40 CFR 122.44(d)(1)(vii)(B)). This means that the VPDES permits identified in the TMDL report must be in compliance with the WLA portion of the TMDL. Compliance is expected at the time the permit is reissued unless the time period between TMDL approval and permit re-issuance is too short to allow compliance. In such a case, a compliance schedule may be employed.

Some point source compliance with the TMDL is required and implemented by the DEQ's VPDES program and will not be covered in this manual.

In most cases, and for NPS dominated watersheds, the WLA portion of the TMDL does not need to be a part of the IP. There is, however, one exception. WLAs will need to be addressed in an IP **for an urban watershed that is covered by a municipal separate storm sewer system (MS4) permit (Phase I or II)**. MS4 permits are National Pollutant Discharge Elimination System (NPDES)-regulated stormwater discharges that must be addressed by the WLA component of a TMDL (40 C.F.R. § 130.2(h)).

Waste Load Allocation (WLA) in TMDL

- WLA compliance will be met through VPDES permits.
- WLA in most cases **will not** be addressed in the IP, with one exception.
- For municipalities with MS4 permits, IP will identify BMPs and monitoring requirements to address the WLA.

Current EPA Region III guidance says that, in most cases, MS4 permits located in TMDL waters can include BMPs and monitoring requirements to improve water quality and address compliance with the TMDL's WLA. The expectation is that, at the time of the next permit reissuance, water quality improvements can be demonstrated. If this is not the case, different control strategies or numeric limits may be required.

The IP completed for an urban watershed should include BMPs designed to reduce pollution from stormwater sources. Persons developing the IP will not deal directly with permit compliance issues. They will, however, deal with identifying BMPs to address the WLA in the TMDL.

4.5.2 Nonpoint Sources

NPS pollution originates from diffuse sources on the landscape (*e.g.*, agriculture or urban) and is strongly affected by precipitation events – runoff from rain or snowmelt (*e.g.*, contaminants in urban stormwater, nutrients in runoff from recreational fields, and bacteria in runoff from confined animal facilities). In some cases, a precipitation event is not required to deliver NPS pollution to a stream (*e.g.*, direct deposition of fecal matter by wildlife or livestock, metals delivered by mine seeps, and contamination from leaking sewer lines or straight pipes). With regard to NPS pollution, source assessments conducted during TMDL development might include a simple identification of potential sources similar to that included in the 303(d) listing (*e.g.*, NPS – agriculture or NPS – urban), or an extensive analysis of land use with consideration for delivery mechanisms (*e.g.*, direct loadings to the stream or land-based loadings that require a precipitation event for delivery of the pollutants to the stream from pervious and impervious surfaces). Table 4.1 gives an example of NPSs, their delivery mechanisms, and temporal variations considered in the “Fecal Coliform TMDL Development for Cedar, Hall, Byers, and Hutton Creeks, Virginia” developed on behalf of DEQ and DCR in March 2000.



Table 4.1 Fecal coliform sources modeled during TMDL development

Source	Delivery Mechanism(s)	Variation
Wildlife		
Deer	Land-Based	Spatial
Canada Goose	Land-Based	Temporal and Spatial
Agricultural		
Beef Cattle	Land-Based & Direct	Temporal and Spatial
Dairy Cattle	Land-Based & Direct	Temporal and Spatial
Sheep	Land-Based	Temporal and Spatial
Horses	Land-Based	Temporal and Spatial
Swine	None	Spatial (100% confined)
Liquid Dairy Manure	Land-Based	Temporal and Spatial
Residential		
Failing Septic	Direct	Spatial
Dogs	Land-Based	Spatial

4.6 Allocation Results and Load Reductions Required to Restore Water Quality

The TMDL report includes a section describing the load allocations to NPSs. Using the model developed for the TMDL study, allocation scenarios are developed that would result in attainment of the water quality standard. The TMDL report also includes a chapter discussing reasonable assurance and implementation. The information given in the implementation chapter can also be helpful in selecting appropriate implementation actions.

For example, overall fecal coliform bacteria NPS load allocations for the Muddy Creek watershed in Rockingham County taken from *Final Report: Fecal Coliform TMDL Development for Muddy Creek, Virginia* are given in Table 4.2 for land-based loads and direct loads. The last column shows the percent reductions needed to attain water quality standards. Land-based loadings need to be reduced by 57%, and direct loadings need to be reduced by 99% to meet the water quality standard. More specifically, looking at direct loads, failing septic systems and uncontrolled discharges have to be completely eliminated. Loadings from cattle in the stream have to be reduced by 99%. Implementation actions must be selected to address these load reductions.

Another example of load reductions is given in Table 4.3. This example represents load reductions for sediment in Blacks Run, Rockingham County, Virginia from *Total Maximum Daily Load (TMDL) Development for Blacks Run and Cooks Creek, Aquatic Life Use (Benthic) Impairment*. This TMDL report shows three agricultural sources (row crops, pasture/hay, and barren) and one urban source of impairment. Implementation actions need to be chosen to reduce sediment loads from row crops (by 38%), pasture/hay (by 37%), barren land (by 70%), and urban sources (by 29%).

Chapter six provides information on implementation actions and a discussion on selecting the appropriate implementation actions to achieve water quality standards.

Table 4.2 Overall fecal coliform bacteria NPS allocations for the Muddy Creek watershed

Land use	Total Annual Loading for Existing Run (Counts/Year)	Total Annual Loading for Allocation Run (Counts/Year)	Percent Reduction
Land-based Loads			
Built-up	1.88E+10	1.88E+10	0%
Farmstead	1.78E+10	1.78E+10	0%
Forest	7.33E+10	7.33E+10	0%
Barren	1.32E+08	1.32E+08	0%
Cropland	2.48E+11	2.16E+11	13.1%
Loafing Lots	4.11E+12	8.08E+11	80.3%
Pasture 1	1.72E+12	1.01E+12	41.3%
Pasture 2	2.19E+11	1.28E+11	41.8%
Pasture 3	3.34E+12	1.94E+12	42.0%
Total Land-based Loads	9.75E+12	4.21E+12	56.8%
Direct loads			
In-stream Cattle	5.82E+14	4.14E+12	99.3%
Failing Septic Systems	7.72E+11	0	100%
Uncontrolled Discharges	8.12E+13	0	100%
Total Direct Loads	6.64E+14	4.14E+12	99.4%

Table 4.3 Sediment allocations for Blacks Run

Source Category	Sediment Load Allocation (lbs/yr)	Sediment - % Reduction
Row Crops	1,616,198	38%
Pasture/Hay	988,461	37
Barren	193,126	70
Forest	12,637	0
Water	0	0
Urban (grouped pervious & impervious areas)	1,801,799	29
Groundwater	0	0
Point Sources (WLA)	32,844	0
Septic Systems	0	0
TMDL Load (minus Margin of Safety)	4,645,065	

5.0 PUBLIC PARTICIPATION

An essential step in implementing a TMDL and putting together a plan for such purpose is the input from a broad range of individuals, agencies, organizations and businesses because of their interest and familiarity with local water quality needs and conditions. Public participation facilitates dialogue between local stakeholders and government agencies to commit resources to TMDL implementation, such as funding and technical support. Community members are best suited to identify and resolve sources of water quality problems. In many watersheds across Virginia, there are a number of diverse watershed planning activities already in place (e.g., basinwide water quality management plans (WQMPs), tributary strategies, Chesapeake 2000 (C2K), watershed plans, roundtables, comprehensive

Things to consider in formulating a public participation process:

- What partnerships currently exist in the watershed that could enhance public participation?
- What media campaigns are currently in place that could enhance public understanding?
- What are the target audiences in the watershed?
- What are the concerns and priorities of the target audiences?
- Which strategies are best suited for reaching and engaging the public in this watershed?

PUBLIC PARTICIPATION in the development of TMDL IPs may be facilitated through:

- public meetings;
- focus groups;
- a steering committee;
- websites;
- the media, and
- mailings.

Components of a TMDL Implementation Plan:

1. Executive Summary
2. Introduction
3. State and Federal Requirements for Implementation Plans
4. Review of TMDL Development
- 5. Public Participation**
6. Implementation Actions
7. Measurable Goals and Milestones
8. Stakeholders' Roles and Responsibilities
9. Integration with Other Watershed Plans
10. Potential Funding Sources

plans, etc.) by individuals, non-profits, and community and government groups. The public participation process for the IP in many cases may be a targeting of these ongoing efforts on a much smaller geographical scale.

The approaches to public participation listed in the text box (left) were successfully used in the development of the first IPs in Virginia, which included the Muddy Creek, Dry River, Pleasant Run, and Lower Dry River watersheds in Rockingham County; Blackwater River watersheds in Franklin County, and Cedar, Hall/Byers, and Hutton Creek watersheds in Washington County. These IPs for fecal coliform TMDLs were developed on behalf of the DCR in 2001.

The public participation chapter of the IP should describe the approaches, such as listed at left, which will be used to inform the public and to solicit input.

Public meetings provide a forum whereby the general public can be informed as to the TMDL requirements, how the IP will be developed, and what actions the IP will require. Focus groups provide a way for a smaller numbers of individuals within the community to come together to address specific implementation issues. A steering committee to consider recommendations that are formulated by the focus groups and to provide overall oversight to the process is also recommended. Other watershed-specific approaches may be developed as well.

5.1 Public Meetings

Often, there may be limited attendance at the two to three public meetings that are held during the TMDL development process. Many individuals are only interested in the bottom line – “What needs to be done to meet the TMDL and how will this impact my personal property?” Therefore, individuals will show up at public meetings for an IP who did not attend TMDL development public meetings. It is suggested that a minimum of two public meetings be held during development of the IP. The first meeting should provide a general description of what a TMDL is, a more detailed description of the TMDL and IP development processes, a presentation on any additional monitoring planned or completed since the TMDL was finalized, and a solicitation for participation in focus groups. The primary purpose of the second public meeting would be to present the draft TMDL IP for public comment. This meeting should be held early enough in the IP development process to allow a 30-day public comment period after the draft IP is presented.

The IP should document the location(s) and attendance at any public meetings and summarize the content of the comments provided.

5.2 Focus Groups

Focus groups, work groups, committees, or teams can be formed to deal with a number of implementation issues such as agricultural, residential, environmental, governmental, etc. The membership of such groups should be generally made up of key individuals who are local leaders and are knowledgeable about the specific issue the focus group is to address. The objective of such groups is to provide input on what is needed to obtain participation in carrying out the IP within the constituents represented or what resources a particular group (e.g. government) may provide. **The IP should summarize the input from each of the focus groups and document recommendations.**

For example, the agricultural focus group could consider how to promote community participation in the implementation of BMPs on agricultural lands to address load reductions for the various NPSs documented in the TMDL. The residential focus group may deal with ways to address pollutant loadings from septic tank failures, straight pipes, and pets for bacteria TMDLs, and even stormwater issues in some of the urbanized watersheds for bacteria and benthic TMDLs. The government focus group could consider what financial and technical resources can be brought to bear to address the TMDL, as well as existing local, state, and federal regulatory authorities. The environmental focus groups could address what their membership may be able to contribute in regards to TMDL implementation.

5.3 Steering Committee

The formation of a steering committee or advisory committee to provide overall oversight in the TMDL implementation process is recommended. Membership on this committee should be comprised of stakeholders from the various focus groups as well as personnel from the key agencies involved in the plan development. This committee would review the recommendations that come forward from the various groups and comments from the public meetings, and provide overall guidance.

5.4 Websites

Information about the TMDL and the development of the IP can be posted on the websites for various agencies and organizations. Also, links can be made to the websites at EPA, DEQ, and DCR to provide more information on the overall federal and state TMDL programs.

5.5 Media

Public service announcements regarding meetings can be posted on local cable channels and on the radio. Announcements can be made available through newspapers and newsletters and on various websites. Stakeholders should coordinate informing the public about the IP through various newsletters that are mailed to residents of the watersheds. A feature story in a local newspaper provides a forum to explain what is happening and how the public can be part of the process.

5.6 Mailings

During the TMDL development process a database of landowners may have been compiled in order to notify watershed residents of public meetings. If such a database is not available, it is suggested that one be compiled from input by the local Soil and Water Conservation District, business and industry, chambers of commerce, clubs and environmental organizations, schools, etc. The watershed residents could be notified of the public meetings and provided fact sheets and other educational materials pertaining to the IP. All mailings should briefly explain the TMDL and IP process and what it means to local citizens in simple and clear language. It is best to avoid using 'TMDL' in the headline as most people are not familiar with this term.

6.0 IMPLEMENTATION ACTIONS

A number of state and federal requirements for IPs are listed in Chapter 3. WQMIRA requires necessary *corrective actions* as one of four elements included in an IP. EPA requires the description of the *implementation actions* and/or *management measures* as one of the minimum elements of an approvable IP. The terms “corrective actions,” “implementation actions,” and “management measures” are used synonymously to describe what is needed to achieve the TMDL. Other terms that may be used are “control measures” and “BMPs”. These terms are used interchangeably throughout this guidance manual.

This chapter explains how to select the appropriate implementation actions and how to quantify the overall implementation effort. By quantifying implementation actions needs, the costs and benefits of implementation can be assessed. The following sections discuss the methodology involved in assessing implementation needs and estimating costs and benefits.

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9. Integration with Other Watershed Plans
10. Potential Funding Sources

THE IMPLEMENTATION ACTIONS chapter of the TMDL Implementation Plan addresses the following questions:

- What types and quantities of implementation actions will be needed to restore water quality?
- What types and quantities of technical assistance will be needed to implement the actions?
- What are the associated costs and benefits of implementing these actions?

An important element of the TMDL IP is to encourage voluntary compliance with implementation actions by local, state, and federal government agencies, business owners, and private citizens. In order to encourage voluntary implementation, information must be obtained on the types of actions and program options that can achieve the goals practically and cost-effectively. Potential implementation actions can be identified through review of the TMDL report, stakeholder input, literature review, and discussions with representatives from the following agencies: Soil and Water Conservation Districts (SWCDs), Natural Resources Conservation Service (NRCS), DCR, DEQ, VDH, Virginia Cooperative Extension (VCE), county governments, local Farm Bureaus, and area colleges and universities.

6.1 Linking the TMDL to Implementation

Linking the TMDL to implementation involves identifying appropriate actions to alleviate the impairment (identifying the implementation actions) and assessing the extent of each implementation action needed. The level of effort required to identify and select the appropriate implementation actions depends on the amount and type of data available from the development of the TMDL, the complexity of the watershed characteristics, and the complexity of the impairment(s) involved. This section is provided to help the planners identify the information already available and the information still needed to select appropriate implementation actions.

6.1.1 Detail of TMDL Analysis

TMDLs vary based on the degree and methodology of the analysis used to determine allocation results and load reductions. Examining the *monitoring*, the *source assessment*, and the *modeling* used to develop the TMDL will provide the information needed to assess the detail of the TMDL analysis.

A review of the TMDL report (see Chapter 4) provides information on the level of detail of the monitoring, source assessment, and modeling efforts involved in determining the TMDL. The level of detail of the TMDL analysis can then be used as one factor in determining the level of effort needed for assessing implementation actions needs. Some general guidelines are given here to identify the level of detail used to obtain the TMDL.

6.1.1.1 Low Detail TMDL Analysis

A simple TMDL analysis with low detail is one that involves *temporal monitoring*, *simple source assessment*, and *simple modeling*. An example of a low-detail TMDL analysis with simple modeling is a "load duration" TMDL analysis. In addition to available historical data, a low-detail TMDL analysis includes temporal monitoring. A simple source assessment includes waste load allocations to each permitted point source within the watershed and NPS load allocations to broad categories of sources within the watershed (*e.g.*, in a TMDL established for bacteria, reductions might be allocated to livestock, wildlife, and human sources based on BST).

LOW DETAIL OF TMDL ANALYSIS:

- **temporal monitoring**
- **simple source assessment**
- **simple modeling**

6.1.1.2 Intermediate Detail TMDL Analysis

An intermediate TMDL analysis involves *temporal and spatial monitoring*, a *rudimentary source assessment*, *assessment of delivery mechanisms*, and some *mid-range modeling*. A rudimentary source assessment includes identifying the point sources of pollution within the watershed and also categorizing the NPS loads based on land use. (Land use data can be obtained from government agencies such as the U.S. Geological Survey (USGS) and the Farm Service Agency (FSA). USGS provides access to its aerial photography products as part of the National Aerial Photography Program (NAPP) at <http://edc.usgs.gov/products/aerial/napp.html>. Additionally, land use data, such as Multi-Resolution Land Characteristics (MRLC) and National Land Cover Data (NLCD) are available from USGS at <http://edc.usgs.gov/products/landcover.html>. Information from FSA's Aerial Photography Field Office can be accessed from <http://www.apfo.usda.gov/>. These are some of the commonly used sources of land use data, however, other sources are often available and may be more appropriate for specific applications. County offices (*e.g.*, GIS departments) and regional representatives of government agencies can often provide useful input as to locally appropriate data.)

INTERMEDIATE DETAIL OF TMDL ANALYSIS:

- **temporal and spatial monitoring**
- **rudimentary source assessment**
- **assessment of delivery mechanisms**
- **mid-range modeling**

HIGH DETAIL OF TMDL ANALYSIS:

- **temporal and spatial monitoring**
- **extensive source assessment**
- **assessment of delivery mechanisms**
- **detailed modeling**

Assessment of delivery mechanisms consists of determining the pathway(s) of the pollutant to the

stream. Mid-range modeling might include monthly or annual loading models, such as GWLF or USLE, commonly used to model nutrients and sediment loadings.

6.1.1.3 High Detail TMDL Analysis

A highly detailed TMDL analysis involves *temporal and spatial monitoring* throughout the watershed, an *extensive source assessment*, *assessment of delivery mechanisms*, and *detailed modeling* of the pollution loads within the watershed. An extensive source assessment includes utilizing available land use studies (such as those previously cited), visual methods such as stream walks, geographic information system (GIS) tools, public or citizen information, and federal or state agency databases. An assessment of the delivery mechanisms determines the pathways from which the pollutant enters the surface waters. This approach provides a local verification process that will lower the level of effort needed to select the implementation actions. Models such as HSPF that are used in a highly detailed TMDL analysis are continuous watershed simulation models that require detailed input data.

6.1.2 Impairment and Watershed Characteristics

Classifying the TMDL analysis is only one factor when determining the level of effort needed for assessing implementation needs. This level of effort is also dependent upon the characteristics of the watershed and the complexity of the impairment.

The number of sources that contribute to the impairment and the land uses within the watershed define the *watershed characteristics* which are factors used to determine the level of effort for assessing implementation needs. For example, selecting implementation actions that address a stream segment impaired by a single identifiable source, such as livestock, will be relatively simple. But establishing BMPs that address multiple pollutant sources (such as sewer overflows and urban stormwater as well as industrial point sources) or multiple land uses within the watershed would be much more involved.

Watershed Characteristics that influence assessment of implementation needs can be defined by:

- **number of sources that contribute to the impairment(s)**
- **land uses within the watershed**

Characteristics of the Impairment that influence assessment of implementation needs can be defined by:

- **type of impairment(s)**
- **number of pollutants**

The type of impairment and the number of pollutants contribute to the complexity of the *impairment*. IPs developed for more than one pollutant, such as the IP developed for the Muddy Creek, Dry River, Pleasant Run, and Lower Dry River watersheds in Rockingham County (for fecal coliform and nitrate reductions), will involve a higher level of effort to assess implementation needs.

6.1.2.1 Low Complexity Impairment and Watershed Characteristics

A *single pollutant* from a *single source* where there is only one overwhelmingly predominant *land use* involved can be classified as an impairment and watershed of low complexity. A bacterial impairment caused by sewer overflow (single pollutant) in an urban watershed (single land use) is defined as a low complexity impairment.

Low Complexity of Impairment and Watershed Characteristics can be defined by:

- **single pollutant**
- **single source**
- **homogeneous land use**

6.1.2.2 Intermediate Complexity Impairment and Watershed Characteristics

A *single pollutant* that can be from a *single source* or *multiple sources* can be classified as an impairment and watershed of intermediate complexity. To be defined as an impairment of intermediate complexity from a single source, the pollutant source comes from *mixed land use*, such as bacterial impairment from agricultural and residential land uses. An impairment of intermediate complexity from multiple sources has more than one source of pollutant but only one *homogeneous land use*. For example, stream bank erosion from cattle and runoff from pastures are pollutant sources causing sediment impairment on agricultural land.

Intermediate Complexity of Impairment and Watershed Characteristics can be defined by:

- **single pollutant**
- **single source**
- **mixed land use**

or

- **single pollutant**
- **multiple sources**
- **homogeneous land use**

6.1.2.3 High Complexity Impairment and Watershed Characteristics

An impairment and watershed of high complexity is due to a *single pollutant* or *multiple pollutants* caused by *multiple sources* and/or *mixed land use*. All general standard (benthic) impairments can be defined as high complexity impairments because the health of aquatic communities, which is the gage by which this standard is measured, responds to a wide variety of environmental factors (stressors). The complexity of the relationship between the health of aquatic communities and the stressors impacting that health makes these impairments highly complex. A TMDL IP that addresses multiple pollutants for the same water body has a highly complex set of impairments.

High Complexity of Impairment and Watershed Characteristics can be defined by:

- **single or multiple pollutants**
- **multiple sources**
- **mixed land use**

6.1.3 Level of Effort for Assessing Implementation Actions

Figure 6.1 shows the level of effort for assessing implementation needs dependent on the type and amount of information available from the TMDL process. Column 1 of Figure 6.1 describes the detail involved in the TMDL analysis, with the characteristics of low, intermediate and high detail TMDL analyses in the shaded boxes. (These characteristics are discussed in Section 6.1.1.) Column 2 of Figure 6.1 displays the complexity of the impairment(s) and watershed characteristics identified during TMDL development. (These characteristics are discussed in Section 6.1.2.) Column 3 gives the level of effort for assessing implementation needs and the suggested tasks needed to select the appropriate implementation actions.

Figure 6.1 shows that if the TMDL analysis was conducted using minimal data (low detail analysis), a higher level of effort for assessing implementation needs (column 3) is required than for one in which the TMDL was determined using considerable data (intermediate or high detail analysis). Also, the level of effort required for assessing implementation actions for a TMDL increases with the complexity of the watershed characteristics and the impairments (column 2).

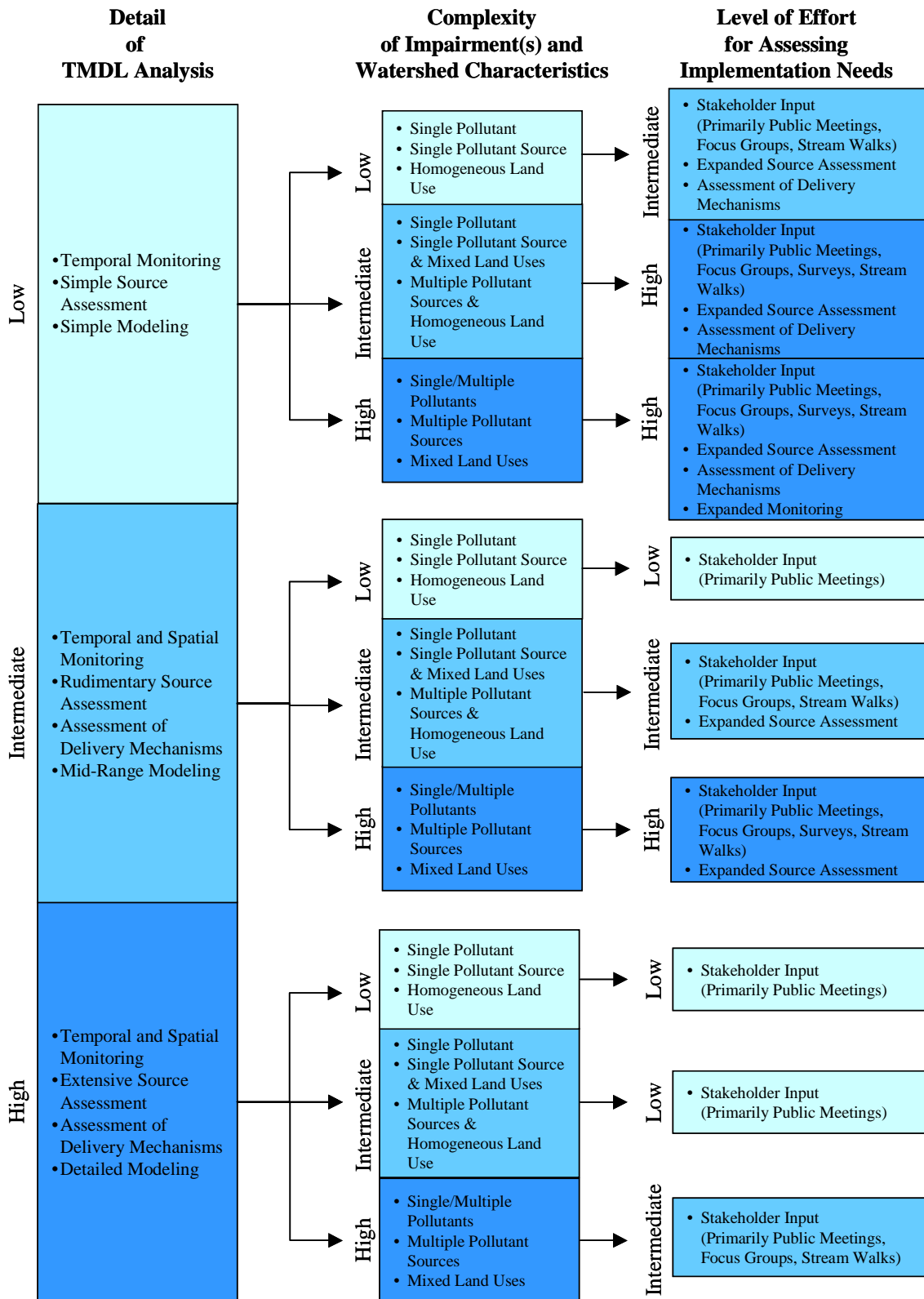


Figure 6.1 Relationships between TMDL development and the IP

6.1.3.1 Low Detail of TMDL Analysis;

Low Complexity Impairment and Watershed Characteristics

When load allocations were estimated using a simple (low detail) TMDL analysis and the complexity of the impairment is identified as low; the assessment of needs and costs, and the identification of funding sources can be achieved with stakeholder input, by expanding the source assessment, and by assessing the delivery mechanisms during implementation planning.

Stakeholder input and public involvement, such as public meetings (Section 5.1), focus groups (Section 5.2), and stream walks, will be needed during the development of the IP to assess the implementation needs.

Application of load duration methodology and BST during bacterial TMDL analysis provides identification of the pollution source (*i.e.*, humans, pets, and wildlife) but not the delivery mechanism within the watershed. An expanded source assessment could include the use of multiple-tracers for tracking the source of human wastewater, particularly in urban watersheds. The multiple tracer approach could include:

- chemical and biological tracers (such as conductivity, temperature, turbidity, dissolved oxygen, surfactants, chloride, bromide, and boron);
- optical brighteners;
- analysis of organic compounds frequently associated with human wastewater (caffeine, nicotine, metabolites, human pharmaceuticals, and detergent metabolites);
- fluorometric analysis for human wastewater plumes; and
- bacteria enumeration and source tracking.

6.1.3.2 Low Detail of TMDL Analysis;

Intermediate Complexity Impairment and Watershed Characteristics

If the TMDL analysis was generated with a low level of detail for an impairment of intermediate complexity, a high level of effort is needed to develop the IP. The assessment of needs, the assessment of the costs and benefits, and the identification of funding sources can be achieved with extensive stakeholder input, by expanding the source assessment, and by assessing the delivery mechanisms.

STAKEHOLDER INPUT:

- **public meetings**
- **focus groups**
- **surveys**
- **stream walks**

A high level of effort requires public meetings (Section 5.1) and focus groups (Section 5.2) to address the needs of the TMDL IP. Surveys, along with stream walks, may also be helpful in identifying sources in the watershed. Appendix A provides

examples of surveys that were used for the TMDL IP in Muddy Creek, Dry River, Pleasant Run, and Lower Dry River watersheds in Rockingham County, Virginia.

The source assessment provided by the TMDL will most likely need to be expanded to address the complexity of the impairment and the watershed characteristics. Public information can be obtained from stakeholder input. Federal and state agency databases (EPA, USDA NRCS, DEQ, DCR, and local conservation districts) can provide land use information, as can stream walks and GIS analyses.

6.1.3.3 Low or Intermediate Detail of TMDL Analysis;

High Complexity Impairment and Watershed Characteristics

If the TMDL analysis was generated with a low or intermediate level of detail for an impairment of high complexity, a high level of effort is needed to develop the IP. The assessment of needs, the assessment

of the costs and benefits, and the identification of funding sources can be achieved with extensive stakeholder input and by expanding the source assessments from the TMDL. In addition, assessment of delivery mechanisms and expanded monitoring is likely to be needed when a low detail TMDL analysis is provided.

The source assessments provided by the TMDL report need to be expanded to address the complexity of the impairment and the watershed characteristics. Public information can be obtained from stakeholder input, *e.g.*, public meetings (Section 5.1), focus groups (Section 5.2), surveys, and stream walks. Federal and state agency databases (EPA, USDA NRCS, DEQ, DCR, and local conservation districts) provide land use information, as can stream walks and GIS tools.

A source assessment includes identifying all of the sources within a watershed. For bacterial or sediment impairment, sources are typically separated into urban and rural components. For a nutrient impairment, atmospheric sources may also need to be considered. A source assessment for a general standard (benthic) impairment located in a mining area would include NPS from acid mine drainage (mine seeps) and runoff from abandoned mine lands. To expand the source assessment for a shellfish TMDL, a shoreline sanitary survey completed by the VDH, Bureau of Shellfish Sanitation, can be useful in identifying NPSs of pollutants. This survey includes a general description of the surveyed region as well as sewage pollution sources, non-sewage pollution sources, boating activity, and animal pollution within the surveyed area.

The development of an IP with only minimal monitoring and a highly complex impairment could be improved with expanded water quality monitoring. Water quality data will typically be needed at various points within the watershed on at least a bi-monthly basis. Monitoring sites should be chosen based on land use and hydrography to represent areas of comparable size, equally distributed sites throughout the watershed, and to isolate influences from pollutant sources (*e.g.*, human, wildlife, livestock, fertilizers).

6.1.3.4 Intermediate or High Detail of TMDL Analysis;

Low Complexity Impairment and Watershed Characteristics

For an impairment and watershed characteristics of low complexity with an intermediate or high level of detail involved in TMDL analysis; estimating the implementation actions needed, estimating the costs, and identifying funding sources can be achieved with stakeholder input because of efforts expended during the TMDL process to define sources and delivery mechanisms. This assessment can most likely be achieved through public meetings (Section 5.1).

6.1.3.5 Intermediate Detail of TMDL Analysis;

Intermediate Complexity Impairment and Watershed Characteristics

If the TMDL analysis was generated with an intermediate level of detail for an impairment of intermediate complexity, an intermediate level of effort is needed to develop the IP. The assessment of needs, the assessment of the costs and benefits, and the identification of funding sources can be achieved with moderate stakeholder input and by expanding the source assessment from the TMDL report.

In this case, public meetings (Section 5.1), focus groups (Section 5.2) and stream walks are needed to address the needs of the TMDL IP. Sources and their delivery mechanisms need to be identified. Stream walks and GIS can be used to identify sources.

6.1.3.6 High Detail of TMDL Analysis;

Intermediate Complexity Impairment and Watershed Characteristics

If the TMDL analysis was generated with a high level of detail for an impairment of intermediate complexity, a low level of highly specialized effort is needed to develop the IP. The assessment of needs, the assessment of the costs and benefits, and the identification of funding sources can be achieved with minimal stakeholder input and by using the existing source assessment from the TMDL report.

6.1.3.7 High Detail of TMDL Analysis;

High Complexity Impairment and Watershed Characteristics

If the TMDL analysis was generated with a high level of detail for an impairment of high complexity, an intermediate level of effort is needed to develop the IP. The assessment of needs, the assessment of the costs and benefits, and the identification of funding sources can be achieved with stakeholder input from public meetings (Section 5.1), focus groups (Section 5.2), and stream walks; and by using the existing source assessment and the existing monitored data from the TMDL report.

6.1.4 Draft and Approved TMDL Reports and TMDL Implementation Plans

For more information on draft TMDLs, approved TMDLs, and TMDL IPs for the state of Virginia, visit <http://www.deq.state.va.us/tmdl/tmdlrpts.html>.

6.2 Assessment of Implementation Action Needs

6.2.1 Identifying Implementation Actions

Implementation actions will need to be assessed based on cost, availability of existing funds, reasonable assurance of implementation, and water quality impact projections. Implementation actions chosen should be practical, cost-effective, equitable (*i.e.*, dealing fairly with all problem areas), and based on the best science and research that is available. Implementation of the identified corrective actions should be administered in a timely manner to efficiently and economically improve problem areas through staged implementation.

The cost of installing and administering implementation actions can be determined through discussions with local contractors as well as with representatives from focus groups (Section 5.2), the local SWCD, NRCS, DCR, DEQ, VDH, VCE, the local government, the local Farm Bureau, and local industries. Implementation actions that can be promoted through existing programs should be identified; the availability of these existing programs can be determined through discussions with personnel from SWCD, NRCS, DCR, DEQ, and VDH. Implementation actions that are not currently supported by existing programs (and their potential funding sources) should also be identified.

The allocations determined during TMDL development largely dictate the actions that must be employed during implementation. For example, for a bacterial TMDL that indicates 100% reduction in direct deposit from livestock, some form of stream exclusion will be necessary (*i.e.*, fencing may be the obvious solution; however, the type of fencing, the distance from the stream bank, and the most appropriate management strategy for the fenced pasture are important, though possibly less obvious, factors).

Some Virginia cost-share programs require participants to follow the specifications established by NRCS. For instance, for the example given above, fencing must be installed 25 feet from the stream bank at a minimum. Five-strand non-electric, or 2-strand electric, fencing is recommended for excluding cattle from a stream; fencing for other types of livestock may require additional or reduced deterrents.

Once the appropriate implementation actions have been determined, the next step is to gather information on costs for the equipment, structures, installation, and assistance that are necessary for the successful implementation of those actions. Unit costs for implementation actions can be determined through information from local contractors, focus group members, and local SWCD representatives. In addition, DCR maintains a database of costs related to corrective measures for pollutants related to agricultural practices (the Agricultural BMP Database.) Information from these sources should be gathered, and the average unit cost should be established. It may also be desirable to project the lowest estimated cost and the highest estimated cost for each necessary item to provide a range of expected costs.

Once the average unit cost is established, the number of total units that are needed must be multiplied by that cost. For example, if a stream segment needs 1000 feet of fencing as an implementation action, the 1000 feet must be multiplied by the average cost per foot of fencing to determine the cost of the implementation action. It is important to consider and add in any additional costs associated with the implementation of the corrective actions, as well as technical or administrative support and maintenance costs. For instance, in keeping with the example given above, while streamside fencing will effectively exclude livestock from the stream, this solution will also necessitate an alternative water source (*e.g.*, wells, spring developments, pumped stream water, or public water.)

It is important to consider future TMDL needs for the watershed when establishing an IP. For example, the first TMDL IPs in Virginia (which included the Muddy Creek, Dry River, Pleasant Run, and Lower Dry River watersheds in Rockingham County; Blackwater River watersheds in Franklin County; and Cedar, Hall/Byers, and Hutton Creek watersheds in Washington County) were developed for bacterial TMDLs. However, implementation practices recommended to reduce bacteria loadings could reduce other pollutants (*e.g.*, sediment and nutrients) addressed in future TMDLs. It is important to remember that a thorough implementation of a well-thought out plan will result in desired improvements to water quality.

Very often, there are ongoing costs associated with technical and administrative assistance, and these need to be carefully considered in order to come up with a reasonable cost estimate for the implementation. The SWCD, DCR staff, and members of focus groups (Section 5.2), can work together in determining reasonable figures for the number of man-hours needed for technical and administrative assistance, as well as the resulting costs for salary, benefits, travel, and training.

Tables 6.1 – 6.5 specify some of the BMPs that are effective in improving water quality, grouped according to impairment source. Appendix B provides descriptions of these BMPs.

Table 6.1 BMPs applicable to bacteria
(for descriptions of these BMPs, please refer to Appendix B)

BACTERIA

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE			EFFICIENCY	AVG COST	UNIT	NOTES
	AGRICULTURE	MINING	URBAN				
Animal waste management				75 %			
Artificial wetland/rock reed microbial filter							
Compost facility					\$5.00	cu. ft. storage	
Conservation landscaping							
Detention ponds/basins				25 %			
Diversions/earthen embankments					\$2.21	lin. ft.	
Drip irrigation							
Fencing				75 %	\$1.78	lin. ft.	does not include cost of charger & gates
Filtration (e.g., sand filters)				30 %			
Infiltration basin				50 %			
Infiltration trench				50 %			
Irrigation water management							
Lagoon pump out							
Land-use conversion							
Limit livestock access							
Litter control							
Livestock water crossing facility				100 %	\$27.40	lin. ft.	reduction in direct deposition

BACTERIA

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE			EFFICIENCY	AVG COST	UNIT	NOTES
	AGRICULTURE	MINING	URBAN				
Manufactured BMP systems							
Onsite treatment system installation							
Porous pavement				50 %			
Proper site selection for animal feeding facility							
Rain garden /bioretention basin				40 %			
Range and pasture management				50 %			
Retention ponds/basins				32 %			
Riparian buffer zones				43 – 57 %	\$547.00	acre	forested buffer w/o incentive payment
Septic system pump-out				5 %			
Sewer line maintenance (e.g., sewer line flushing)							
Stream bank protection and stabilization (e.g., riprap, gabions)				40 - 75 %	\$47.00	lin. ft.	40 % w/o fencing; 75 % w. fencing
Terraces					\$1.70	lin. ft.	
Vegetated filter strip					\$99.00	acre	
Waste system/storage (e.g., lagoons, litter shed)				80 – 100 %	\$27,272	system	
Water treatment (e.g., disinfection, flocculation, carbon filter system)							
Wetland development/enhancement				30 %	\$859.00	acre	includes creation and restoration

Sources: BMP Efficiencies Chesapeake Bay Watershed Model (Phase IV) August 1999; Draft FC and Nitrate TMDL IP for Dry River (2001); EPA (1998); EPA (1999b); Novotny (1994); Storm Water Best Management Practice Categories and Pollutant Removal Efficiencies (2003); USDA (2003); DCR (1999); DEQ/DCR (2001).

Table 6.2 BMPs applicable to metals
(for descriptions of these BMPs, please refer to Appendix B)

METALS

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE		EFFICIENCY	AVG COST	UNIT	NOTES
	MINING	URBAN				
Artificial wetland/rock reed microbial filter						
Avoid adding materials containing trace metals						
Conservation landscaping						
Detention ponds/basins						
Diversions/earthen embankments				\$2.21	lin. ft.	
Filtration (e.g., sand filters)						
Green rooftops						
Integrated pest management						
Land-use conversion						
Litter control						
Manufactured BMP systems						
Rain garden /bioretention basin						
Re-mining						
Retention ponds/basins						
Street sweeping						
Water treatment (e.g., disinfection, flocculation, carbon filter system)						

Sources: EPA (1999b); Novotny (1994); USDA (2003); DCR (1999); DEQ/DCR (2001).

Table 6.3 BMPs applicable to nutrients
(for descriptions of these BMPs, please refer to Appendix B)

NUTRIENTS*

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE			EFFICIENCY	AVG COST	UNIT	NOTES
	AGRICULTURE	MINING	URBAN				
Animal waste management				75%			
Compost facility					\$5.00	cu. ft. storage	
Conservation landscaping							
Conservation tillage							
Contour farming					\$5.00	acre	
Cover crops and rotations				15 – 35%			
Critical area planting					\$998.00	acre	
Crop rotations							
Crop/plant variety selection							
Detention ponds/basins				5 - 10%			
Diversions/earthen embankments					\$2.21	lin. ft.	
Drip irrigation							
Fencing				75%	\$1.78	lin. ft.	does not include cost of charger & gates
Field borders					\$100.00	acre	
Grassed waterways/swales				40-60%	\$1,875	acre	
Infiltration basin				50-70%			
Infiltration trench				50-70%			
Irrigation water management							

NUTRIENTS*

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE			EFFICIENCY	AVG COST	UNIT	NOTES
	AGRICULTURE	MINING	URBAN				
Lagoon pump out							
Land-use conversion							
Limit livestock access							
Litter control							
Livestock water crossing facility					\$27.00	lin. ft.	
Manufactured BMP systems							
Nutrient management				13 – 25 %	\$73.00	acre	
Onsite treatment system installation							
Porous pavement				50 – 70 %			
Proper site selection for animal feeding facility							
Rain garden/bioretention basin				40 – 60 %			
Range and pasture management				25 – 50 %			
Retention ponds/basins				30 – 50 %			
Riparian buffer zones				57 – 70 %	\$547.00	acre	forested buffer w/o incentive payment
Roof down-spout system					\$3.42	lin. ft.	
Septic system pump-out				5%			
Stream bank protection and stabilization (<i>e.g.</i> , riprap, gabions)				40 – 75 %	\$47.00	lin. ft.	40% w/o fencing; 75% w/ fencing
Strip cropping							
Terraces					\$1.70	lin. ft.	

NUTRIENTS*

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE			EFFICIENCY	AVG COST	UNIT	NOTES
	AGRICULTURE	MINING	URBAN				
Vegetated filter strip					\$99.00	acre	
Waste system/storage (e.g., lagoons, litter shed)					\$27,272	system	
Water treatment (e.g., disinfection, flocculation, carbon filter system)							
Wetland development/enhancement				30 – 50 %	\$859.00	acre	includes creation & restoration

Sources: BMP Efficiencies Chesapeake Bay Watershed Model (Phase IV) August 1999; EPA (1998); EPA (1999b); Novotny (1994); Storm Water Best Management Practice Categories and Pollutant Removal Efficiencies (2003); USDA (2003); DCR (1999); DEQ/DCR (2001).

*Nutrients - No state water quality standards, potential stressors for benthic impairments.

Table 6.4 BMPs applicable to pH
 (for descriptions of these BMPs, please refer to Appendix B)

pH

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE	EFFICIENCY	AVG COST	UNIT	NOTES
	MINING				
Artificial wetland/rock reed microbial filter					
Avoid adding materials containing trace metals					
Conservation landscaping					
Land-use conversion					
Manufactured BMP systems					
Re-mining					
Water treatment (<i>e.g.</i> , disinfection, flocculation, carbon filter system)					
Wetland development/enhancement			\$858.00	acre	includes creation & restoration

Sources: Novotny (1994); USDA (2003); DCR (1999); DEQ/DCR (2001).

Table 6.5 BMPs applicable to sediment
(for descriptions of these BMPs, please refer to Appendix B)

SEDIMENT*

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE			EFFICIENCY	AVG COST	UNIT	NOTES
	AGRICULTURE	MINING	URBAN				
Conservation landscaping							
Conservation tillage							
Contour farming					\$5.00	acre	
Cover crops and rotations				15 %			
Critical area planting					\$998.00	acre	
Detention ponds/basins				10 %			
Diversions/earthen embankments					\$2.21	lin. ft.	
Drip irrigation							
Field borders					\$100.00	acre	
Grade stabilization (<i>e.g.</i> , chemical stabilization)							
Grassed waterways/swales				85 %	\$1,875	acre	
Infiltration basin				90 %			
Infiltration trench				90 %			
Land-use conversion							
Limit livestock access							
Livestock water crossing facility					\$27.40	lin. ft.	
Manufactured BMP systems							
Mulching/protective covers							
Rain garden /bioretention basin				85 %			
Retention ponds/basins				80 %			

SEDIMENT*

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE			EFFICIENCY	AVG COST	UNIT	NOTES
	AGRICULTURE	MINING	URBAN				
Riparian buffer zones				70 %	\$547.00	acre	forested buffer w/o incentive payment
Silt fencing							
Spillways: principal / emergency							
Stream bank protection and stabilization (<i>e.g.</i> , riprap, gabions)				40 - 75 %	\$47.00	lin. ft.	40% w/o fencing; 75 % w/ fencing
Street sweeping							
Strip cropping							
Terraces					\$1.70	lin. ft.	
Vegetated filter strip					\$99.00	acre	
Wetland development/enhancement				80 %	\$859.00	acre	includes creation & restoration

Sources: BMP Efficiencies Chesapeake Bay Watershed Model (Phase IV) August 1999; EPA (1998); EPA (1999b); Novotny (1994); Storm Water Best Management Practice Categories and Pollutant Removal Efficiencies (2003); USDA (2003); DCR (1999); DEQ/DCR (2001).

*Sediment - No state water quality standard, potential stressor for benthic impairment.

6.2.2 Quantifying Implementation Actions

An array of implementation actions is available for use during implementation, especially for land-based reductions. An implementation strategy outlining such items as practices stakeholders are most familiar with, anticipated level of public and private funding (*i.e.*, participation in cost-share program), and historical implementation in the particular watershed will enable the list of potential implementation actions to be reduced to a manageable level. Pollutant reductions associated with a combination of practices from this shortened list can then be evaluated. An implementation action could be different for practices that are funded through the State's cost-share program *vs.* private funds. Any practice installed through the use of cost-share programs must meet established specifications, usually resulting in a more complete system, whereas a stakeholder trying to minimize private costs would be inclined to install the minimum practice components that will achieve the implementation goals.

Steps needed to quantify implementation actions include:

- determine measurement unit(s) TMDL reductions will be based on (*e.g.*, length, system, acreage);
- quantify the measurement unit(s); and
- determine number of implementation actions based on each unit using information from implementation actions identification.

Measurement Units Determination

TMDL development methodology, required TMDL reductions, and available data are the key pieces of information used to decide the unit of measurement that TMDL reductions will be based on. Required reductions may be indicative of the level of modeling and source assessment during

TMDL development and will affect the unit of measurement decision. Reductions may state that a source must be reduced by a defined amount without defining the pathway whereby the pollutant is reaching a stream (*e.g.*, runoff from a particular land use or ground water). The selection of the unit of measurement should be implicit when the reduction of impairment is linked to a particular pathway.

Unit Identification Should be Based On

- TMDL methodology
- TMDL reductions
- how TMDL reductions are stated
- available data



Review of available data to perform quantification analyses is necessary to determine the level of confidence that can be achieved. For example, if hydrography and land use data are not sufficient to estimate length of streamside fencing, an estimate of the number of livestock exclusions systems can be used based on the number of farmsteads in the watershed. Examination of historical data (*e.g.*, DCR's BMP Database) can lend insight into the unit of measurement that a practice has customarily been expressed in.

Measurement Unit Quantification

Possible methods to quantify the measurement units include estimates in the TMDL report, verbal communication with stakeholders, and/or spatial analyses. For instance, a stream walk during TMDL development may identify the

Unit Quantification Should be Based On

- the TMDL report
- stakeholder communication
- spatial analysis

number and location of straight pipes contributing bacteria to a stream. Another example is a TMDL allocation to eliminate previously identified mine seeps. Unit quantification may be achieved through verbal communication with stakeholders during IP development, assuming impairment complexity is low. Additional spatial analyses may be required if unit quantification cannot be determined using data from development of the TMDL or stakeholder input. Typical GIS data that is necessary in order to perform spatial analyses include: land use / land cover, stream network, soils, topography, utilities, property lines, farm tracts, easements, and building footprints.

Implementation Action Quantification

The number of units that represents an implementation action must be estimated, typically using historical data describing implementation actions that have been used in the area (utilizing sources such as DCR's BMP Database). The number of implementation actions is calculated by dividing the total units of measurement by the number of units per implementation action.

Implementation Action Quantification Should be Based On

- unit designation
- implementation strategy
- stakeholders' knowledge of practice
- databases

Quantification Examples

The following simplified examples are given to illustrate steps in the quantification process:

- 1) Bacteria reduction from livestock direct deposition;
- 2) Bacteria reduction from failed septic systems direct deposition; and
- 3) Phosphorous reduction from stormwater.

Background

Requirements

Measurement Units Determination

Measurement Unit Quantification

Implementation Action Quantification

TMDL Implementation Plan Guidance Manual

Quantification Example # 2: Direct deposition from failed septic systems

Background

Fecal coliform TMDL
100% load reduction from failed septic systems contributing directly to stream

Requirements

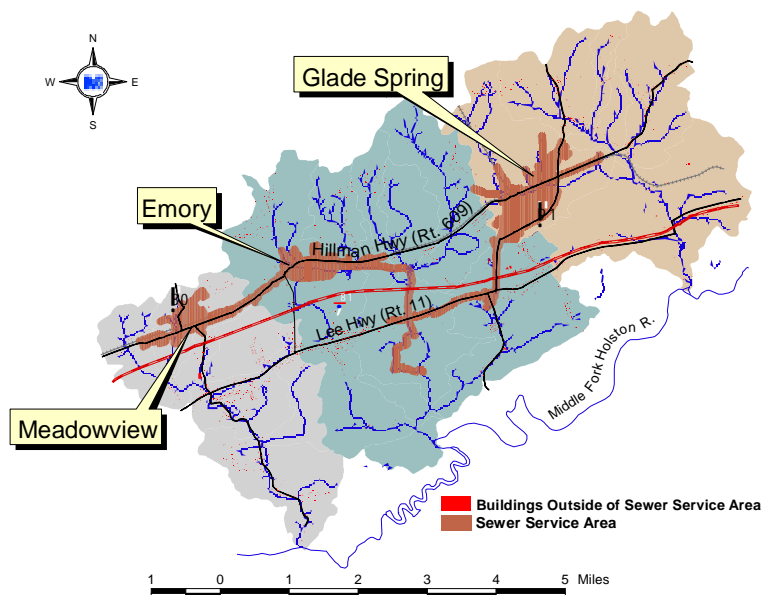
Personnel: need GIS training, knowledge of sewer treatment systems
Software: GIS (*e.g.*, ArcView), spreadsheet
Data Needs: stream network, sewer line, and building footprint GIS layers; sewer ordinance; septic system failure rate

Measurement Units Determination

Measurement unit = failing septic system

Measurement Unit Quantification

Sewer ordinance specifies houses 300' from sewer line must connect
Create 300' buffer around sewer line
Overlay buffer with building footprints to determine houses served by WWTP



Apply septic failure rate to remaining houses to determine total number of failing septic systems that cannot connect to sewer lines
Create 50' buffer around stream
Overlay 50' buffer and houses with failing systems to determine total failing systems contributing directly to stream

Implementation Action Quantification

Determine proportioning scheme for control measures (*e.g.*, based on high and low cost estimates of control measure solution)
Calculate number of pump-outs, new septic systems, and alternative treatment systems needed based on proportion scheme

Quantification Example # 3: Phosphorous reductions from stormwater

Background

Urban watershed
40% load reduction of phosphorous in stormwater

Requirements

Personnel: need GIS training, technically trained (*e.g.*, engineer)
Software: GIS (*e.g.*, ArcView), spreadsheet
Data Needs: zoning ordinances; stream flow; and stream network, soils, land use, topography, utilities, property lines, easements, structure, septic tank/drain field, and building footprint GIS layers

Measurement Units Determination

Measurement unit = retention basin system

Measurement Unit Quantification

Calculate area draining to all streams
Flag areas with a minimum of 15 acres of contributing watershed
Review land use and zoning ordinances for building site restrictions
Calculate buffers around existing site conditions imposing constraints on the location or construction of the basin such as:
 20' from any structure or property line
 100' from septic tank/drainfield
 50' from steep slope (*i.e.*, greater than 15%)
Overlay 15-acre contributing areas with buffers areas not appropriate for basin location, delete areas with overlap
Determine if soils for each site for appropriateness (*i.e.*, permeability, bedrock, Karst, embankment formation, *etc.*), delete areas not meeting criteria
Review flow data to determine if baseflow is sufficient; delete areas not meeting criteria

Implementation Action Quantification

Visually inspect areas to determine total number of retention ponds that would be needed
Calculate impervious area for each drainage area to determine retention basin sizing
Divide total areas between three types of retention ponds based on sizing requirements

6.3 Assessment of Technical Assistance Needs

Sufficient technical assistance and education are keys to getting citizens involved in implementation. There must be a proactive approach by agencies to contact landowners in the impaired watershed(s) to articulate exactly what the TMDL process means to them and what will most practically get the job done. Several education/outreach techniques can be utilized during implementation. Articles describing the TMDL process, the reasons why there is a problem, the methods (*i.e.*, BMPs) through which the problem can be corrected, the assistance that is currently available for landowners to deal with the problem, and the potential ramifications of not dealing with the problem, should be made available through as many channels as possible (*e.g.*, newsletters and targeted mailings). Workshops and demonstrations can be organized to show landowners the extent of the problem, effectiveness of BMPs, and process involved in obtaining technical and financial assistance.

Agricultural

Historically, SWCDs and the NRCS have taken the lead for agricultural technical assistance in Virginia. The level of technical assistance that a full time equivalent (FTE) can be expected to provide during a year must be estimated using historical records or stakeholder assumptions. The Agricultural BMP Database can be utilized to quantify the number and type of agricultural control practices historically designed and implemented through the cost-share program by the local SWCD to estimate the average number of BMPs that an FTE can process in a year. If historical data is not available to determine FTE production, an estimate derived from focus group discussion will need to be utilized. Dividing the total implementation actions needed to be installed per year during implementation by the number of implementation actions that a FTE can process in a year will equal the number of FTE considered necessary for technical assistance during implementation. It is anticipated $\frac{3}{4}$ FTE will be dedicated to technical assistance on design and

installation of implementation actions and that the remaining ¼ FTE will be devoted to educational outreach. The same processes can be used to determine the number of administrative FTE to support the technical FTE per year.

The best forum for the agricultural community may be field days, pasture walks, and presentations offered through local farm groups. Emphasis should be placed on local farmers discussing their experiences with the cost-share programs, demonstrating the advantages of a BMP, and presenting monitoring results to demonstrate the problem. Farmers are more likely to be receptive to individualized discussions with local technical personnel or fellow farmers who have implemented the suggested BMPs than they will be to presentations made at a larger forum. The IP should describe the technical assistance and types of outreach actions identified for the watershed.

Potential technical assistance and educational outreach tasks associated with agricultural programs:

1. Make contacts with landowners in the watershed to make them aware of implementation goals and cost-share assistance programs.
2. Technical assistance for agricultural programs (*e.g.*, survey, design, layout, and approval of installation).
3. Handle and track cost-share.
4. Develop educational materials and programs, based on local needs.
5. Organize educational programs (*e.g.*, pasture walks, presentations at field days or grazing-club events).
6. Distribute educational materials (*e.g.*, informational articles in FSA or Farm Bureau newsletters, local media, *etc.*).
7. Assess and track progress toward BMP implementation goals.
8. Follow-up contact with landowners who have installed BMPs.
9. Coordinate use of existing agricultural programs and suggest modifications where necessary. Include costs for ongoing maintenance and technical assistance.

Residential

The VDH has been the primary organization for managing residential programs. However, depending on the extent of reductions needed, the VDH may not have resources to fully commit to implementation. In previous TMDL implementation projects, the local SWCD has taken the lead (with VDH consultation) on implementing residential implementation actions. Additional technical assistance may be provided through a homeowner's association. Historical work records for an agency/group can be utilized to determine the level of technical assistance that a full time equivalent (FTE) can be expected to provide during a year. If historical data is not available to determine FTE production, an estimate derived from focus group discussion will need to be utilized. Dividing the total implementation actions needed to be installed per year during implementation by the number of implementation actions that a FTE can process in a year will equal the number of FTE considered necessary for technical assistance during implementation. It is anticipated ¾ FTE will be dedicated to technical assistance on design and installation of implementation actions and that the remaining ¼ FTE will be devoted to educational outreach. The same processes can be used to determine the number of administrative FTE to support the technical FTE per year.

Small community meetings (similar to the small workshops proposed for the agricultural community) could be the best forums for educating homeowners about environmental issues and management considerations (e.g., septic system maintenance and disposal of pet waste). Generally, homeowners are unaware of the need for regular septic system maintenance. Notices using all media outlets should be posted regarding septic systems (e.g., a reminder to pump-out septic tank every three to five years). An educational packet can be included about septic system issues for new homeowners. Additionally, educational tools, such as a model septic system that can be used to demonstrate functioning and failing septic systems, and video of septic maintenance and repair will be useful in communicating the problem and needs to the public. The IP should describe the technical assistance and types of outreach actions identified for the watershed.

Potential technical assistance and educational outreach tasks associated with residential programs:

1. Identify failing septic systems and straight-pipes (e.g., stream walks, analysis of aerial photos, monitoring) and report to VDH.
2. Track septic system repairs/ replacements / installations.
3. Handle and track cost-share.
4. Develop educational materials and programs.
5. Organize educational programs (e.g., demonstration on septic pump-outs).
6. Distribute educational materials (e.g., informational pamphlets on TMDLs, and on-site sewage disposal systems).
7. Assess progress toward implementation goals.
8. Follow-up contact with landowners who have participated in the program(s).

6.4 Estimating Costs / Benefits

6.4.1 Costs

An associated cost for each implementation action (excluding technical assistance) is determined during implementation action identification (Section 6.2.1) using historical data, estimates from contractors and builders, and estimates from stakeholders. Multiplying the implementation action cost by the total number of implementation actions, based on results from implementation action quantification (Section 6.2.2), defines the associated cost of materials and labor for each implementation action installation. Separation of costs associated with agricultural, residential, and industrial direct and land-based sources will aid in cost ranking evaluation.

An average cost estimate for each category can be made based on the combination of practices chosen for implementation. For example, high and low cost estimations to fix failed septic systems and replace straight pipes in an impaired segment should be based on the combination of drain-field maintenance, new septic systems, or alternative waste treatment system. The highest cost will be amassed by replacing all failed septic systems and straight pipes with an alternative waste treatment. Contrarily, fixing all failed septic systems with drain-field maintenance and replacing all straight pipes with new septic systems would result in the lowest cost.

Ongoing costs associated with technical and administrative assistance need to be carefully considered in order to come up with a reasonable cost estimate for implementation. The SWCD, DCR staff, and members of focus groups (Section 5.2) can work together in determining reasonable costs for salary, benefits, travel, training, and incidentals for education of technical and administrative staff. Multiplying

these costs with the number of technical and administrative FTE from quantification analysis will provide the agricultural, residential, and industrial technical assistance costs for implementation.

SUMMARY OF STEPS FOR CALCULATING PROJECT COSTS

1. Identify/quantify the corrective actions that are needed
2. Research the unit costs
3. Multiply the unit cost by the number of units required
4. Include costs for ongoing maintenance and technical assistance

6.4.2 Benefits

The primary benefit of implementation is cleaner waters in Virginia, where pollution levels will be reduced to meet water quality standards. This is the primary benefit that should be recognized in the IP. However, the IP should point out that, in addition to and as a result of reducing the amount of specific pollutants, stakeholders can anticipate benefits within their watersheds which may include:

- improved public health,
- conservation of natural resources (*e.g.*, soil and soil nutrients),
- improved aquatic life,
- improved riparian habitat,
- reductions in the amount of flood damage,
- improved recreational opportunities, and
- greater economic opportunities (*e.g.*, improved agricultural production, reopening of shellfish beds, tourism, etc.).

An ancillary benefit is enhanced real estate values for farms, homes, and businesses located near water bodies with good water quality.

The majority of TMDLs being developed in Virginia are bacteria TMDLs. It is hard to gage the impact that reducing bacteria contamination will have on public health, as most cases of waterborne infection are not reported or are falsely attributed to other sources. However, the incidence of infection from pollutant sources, through contact with surface waters, should be reduced considerably, and this should be noted.

TMDLs are pollutant-specific, and a separate TMDL must be developed for each pollutant in a water body that violates water quality standards. In cases where TMDLs have been developed for multiple pollutants for a given water body, the IP should be designed to address the multiple pollutants concurrently. That will allow multiple pollutant problems to be handled at the same time and a system of BMPs to be designed and installed that have added benefits. For example, livestock stream exclusion is used as an implementation action to reduce bacteria loadings to a stream. In fencing off the stream, restoration of the riparian area (typically 25 to 35 feet) through implementation of buffers (grasses and/or trees) also benefits the aquatic habitat and makes progress towards reaching the general water quality standard (benthic) for the same stream. The vegetated buffers that are established reduce sediment and nutrient transport to the stream from upslope locations. These have been identified as the major stressors to benthic aquatic communities in the benthic TMDLs completed in Virginia to date. Stream exclusion that may place the fence at the top of the stream bank would reduce the bacteria

loading, but without the riparian buffer, the additional benefit of reducing sediment and nutrient loadings from the upland would be lost.

On a larger scale, for watersheds located within the Chesapeake Bay watershed, reducing sediment and nutrients loads as a result of BMPs that are installed to improve benthic and bacteria water quality impairments will help obtain implementation goals in the Tributary Strategies.

The main objective of the IP is restoring water quality in our streams with additional benefits that may include continued economic vitality and strength. Healthy waters can improve economic opportunities for Virginians, and a healthy economic base can provide the resources and funding necessary to pursue restoration and enhancement activities. The agricultural, residential, urban, or mining implementation actions recommended in the IP will often provide economic benefits to the landowner, along with the expected environmental benefits. For example, exclusion of cattle from streams leads to the development of alternative (clean) water sources. This provides an opportunity for intensive pasture management and improved nutrient management. Further details on these benefits can be found in existing TMDL IPs which include the Muddy Creek, Dry River, Pleasant Run, and Lower Dry River watersheds in Rockingham County; Blackwater River watersheds in Franklin County; and Cedar, Hall/Byers, and Hutton Creek watersheds in Washington County. Additionally, money spent by landowners, government agencies, and non-profit organizations in the process of implementing the IP will stimulate the local economy.

The residential programs will play an important role in improving water quality, since human waste can carry with it human viruses in addition to the bacterial and protozoan pathogens that all fecal matter can potentially carry. In terms of economic benefits to homeowners, an improved understanding of private sewage systems, including knowledge of what steps can be taken to keep them functioning properly and the need for regular maintenance, will give homeowners the tools needed for extending the life of their systems and reducing the overall cost of ownership. The average septic system will last 20-25 years if properly maintained. Proper maintenance includes; knowing the location of the system components and protecting them by not driving or parking on top of them, not planting trees where roots could damage the system, keeping hazardous chemicals out of the system, and pumping out the septic tank every three to five years. The cost of proper maintenance, as outlined here, is relatively inexpensive in comparison to repairing or replacing an entire system.

Cleaner waters in Virginia will result in improved public health, conservation of natural resources, improved aquatic habitat, and greater economic opportunities for Virginians. These benefits add up to a better quality of life in the Commonwealth of Virginia; the recognition of these effects and their applicability in watersheds will help to ensure a successful implementation.

7.0 MEASURABLE GOALS AND MILESTONES FOR ATTAINING WATER QUALITY STANDARDS

7.1 Establishing Milestones

The end goals of implementation are 1) restored water quality in the impaired waters, and 2) subsequent de-listing of the waters from the Commonwealth of Virginia's 303(d) List of Impaired Waters. Progress toward end goals can be assessed during the implementation process through tracking of control measure installations and continued water quality monitoring. In establishing measurable goals, it is recommended that a baseline be established against which future progress of reducing pollutants can be measured. For example, information on current water quality conditions and the numbers of BMPs already implemented is needed to set this baseline.

The MEASURABLE GOALS AND MILESTONES chapter of the Implementation Plan should address the following questions:

- Who will be responsible for tracking control measure installations?
- What are the implementation milestones?
- What type of water quality monitoring will be continued during implementation?
- What annual goals are to be achieved during implementation?
- What are the methods to be used to assess "reasonable assurance" of successful implementation?
- What methods will be used during implementation for evaluating progress?
- What actions will be taken if water quality standards are not attained?

Components of a TMDL Implementation Plan:

1. Executive Summary
2. Introduction
3. State and Federal Requirements for Implementation Plans
4. Review of TMDL Development
5. Public Participation
6. Implementation Actions
- 7. Measurable Goals and Milestones**
8. Stakeholders' Roles and Responsibilities
9. Integration with Other Watershed Plans
10. Potential Funding Sources

An appropriate local entity responsible for tracking implementation actions should be identified during the development of the IP. The Virginia Agricultural Best Management Practices Cost-Share Program is the most likely tool to use for tracking implementation actions involving agriculture. (For more information, contact DCR or refer to their website www.dcr.state.va.us/sw/costshare.htm.) Other organizations for tracking implementation actions are local Planning District Commissions (PDCs) for residential or urban implementation actions, the Department of Mines, Minerals and Energy's (DMME) Division of Mined Land Reclamation for mining implementation actions, or VDH Bureau of Shellfish Sanitation for implementation actions used for shellfish TMDLs.

Expected progress in implementation is established with two types of milestones, *implementation*

milestones and *water quality milestones*. Implementation milestones establish the percentage of implementation actions installed within certain timeframes. (For example, 50% of exclusion of livestock out of the stream within first two years, or 75% of elimination of illicit sewage discharge within the first year.) Water quality milestones establish the corresponding improvements in water quality that can be expected as the implementation milestones are met. The establishment of implementation milestones and water-quality milestones are inextricably linked. The process consists of a trade-off between quickly attaining water-quality goals and the availability of implementation resources.

7.1.1 Implementation Milestones

7.1.1.1 *Considerations when establishing implementation milestones*

Implementation milestones can be established based on anticipated or modeled effects of various implementation levels of BMPs and discussion with local field personnel and stakeholders. Some specific items that should be considered when setting implementation milestones are listed in the accompanying text box.

Funding sources should be identified during the development of the IP. Available grant and loan programs will most likely have contract schedules with specific time limits. The time frame of available funding needs to be considered when setting implementation milestones. A list of potential funding sources is provided in Chapter 10.

Resource availability has to be taken into consideration when developing implementation milestones. The installation of some BMPs requires expertise or equipment that only specific contractors can provide (*e.g.*, pump-outs and repairs of failing septic systems, design and construction of detention basins). In these situations, the implementation milestones must be set in consideration of the number of contractors available to provide assistance, and the time it takes to install and implement the BMP. For example, in a watershed where streamside fencing is one of the selected BMPs, consideration has to be given to the number of contractors available to install fencing, as well as the availability of fencing materials, the time it takes to order and purchase these materials if they are not in stock locally, and the hours needed to complete the installation.

When setting implementation milestones, it is important to consider the number of stakeholders currently involved in the TMDL process and how much more involvement is necessary to carry out a successful IP. Some implementation milestones may have to allow for further informing and acceptance by the public, particularly the stakeholders (*e.g.*, landowners and renters within the watershed), of the BMPs to be implemented.

Some implementation actions require an extensive time period before water quality improvements can be measured. For example, improvements in water quality from planting trees along a stream will not be measurable until the trees have been in place for some time.

7.1.1.2 *Staged Implementation*

The implementation of BMPs in the impaired watershed will be accomplished in stages. In general, the Commonwealth intends for the required reductions to be implemented in an iterative process that addresses first the sources with the largest impact on water quality. The staged implementation approach allows an achievable plan to be developed. Monitoring should continue throughout the process to document progress toward goals and to provide a mechanism for evaluating the effectiveness of the implementation actions as well as their suitability for achieving intended water quality goals. The benefits of staged implementation are 1) as stream monitoring continues to occur, it allows for water quality improvements to be recorded as they are being achieved; 2) it provides a measure of quality control, given the uncertainties which exist in any model; 3) it provides a mechanism for developing public support; 4) it helps to ensure that the most cost-effective practices are implemented initially; and 5) it allows for the evaluation of the adequacy of the TMDL in achieving the water quality standard.

Items to be considered when establishing IMPLEMENTATION MILESTONES:

- Funding sources – start-up and stop dates
- Resource availability (*i.e.*, contractors, technical assistance)
- Stakeholders' participation and level of pertinent knowledge
- Time needed to establish effectiveness of BMPs

Staged implementation can be used as an aid for establishing implementation milestones. The Stage I goal focuses on implementing the most effective BMPs first. In most cases, the TMDL report will outline a Stage I goal that may be based on meeting an interim standard or addressing a set of human impacts. Specific Stage I goals for BMP implementation will be established as part of the IP development process.

An example of staged implementation to obtain the water quality standard for bacteria in a watershed in which the predominant land uses are agricultural and residential is as follows:

- **Stage I:** Eliminate direct inputs to the stream from humans and reduce direct inputs from livestock.
- **Stage II:** Further reductions in direct inputs from livestock and eliminate input from near-stream sources (such as loafing and feed lots, and manure storage areas) as well as inappropriate manure application near stream and failing septic systems in the near-stream areas.
- **Stage III:** Eliminate input from far upland sources (such as loafing and feed lots, and manure storage areas) as well as inappropriate manure application and failing septic systems in the upland areas.

7.1.2 Water Quality Milestones

Water quality milestones establish the corresponding improvements in water quality that can be expected as the implementation milestones are met. Water quality monitoring is the mechanism for tracking water quality improvements and thus determining and evaluating the success of the IP.

At a minimum, water quality milestones should be assessed using DEQ's ambient water quality data. There are, however, other potential sources that may also provide data useful in assessing the water quality milestones. The DEQ ambient monitoring program and other potential sources of monitoring data are discussed below.

7.1.2.1 DEQ ambient monitoring

The DEQ has made water quality monitoring in support of TMDL development and implementation a priority. *Virginia's Water Quality Monitoring Strategy* (draft, 1999) outlines the current procedure for water quality monitoring for stream segments that are undergoing TMDL implementation. The current draft *Strategy* states that IP monitoring will probably be needed in the fiscal year following the actual installation of BMPs or a similar event-triggered target date set by DEQ and DCR TMDL staff. The monitoring could come from normal station rotation at the beginning of the fiscal year (if in phase with TMDL IP needs), via special study, or from a permanent trend station located within the TMDL watershed.

To ensure that the watershed undergoing TMDL implementation has monitoring coverage for a given year, the DEQ central office TMDL Monitoring Coordinator will need to be contacted by December 31st. DEQ, with the assistance of DCR, will identify the location of stations to be monitored for TMDL implementation and include them in the DEQ annual monitoring plan. The monitoring would begin in July.

DEQ ambient monitoring for TMDL implementation will not include BST. It is anticipated that BST data will be collected by DEQ only during the TMDL development process. For a bacterial impairment, water quality analysis collected by sources other than DEQ may include BST analysis.

7.1.2.2 Other sources of monitoring data

Other sources of monitoring data may be available in addition to the DEQ ambient water quality data. These sources may include, but are not limited to, citizen monitoring data, special studies, and monitoring by localities. For information on citizen monitoring in Virginia, contact DEQ's citizen monitoring coordinator (website: <http://www.deq.state.va.us/cmonitor/>, email: citizen@deq.state.va.us; or phone: (804) 698-4026 or 800-592-5482). To find out if localities have monitoring programs in your area, contact the county's or city's environmental division.

7.1.3 Linking Implementation Actions to Water Quality

7.1.3.1 Direct Method

A simple approach to linking implementation milestones to water quality milestones is to assume that improvements in water quality are directly related to implementation actions. For example, an IP is being developed for a general standard TMDL in an urban watershed in which sediment loads to the stream need to be reduced by 30%. The implementation planning team has decided that stormwater runoff is the main source of sediment impairment. This team has decided that the installation of six detention ponds within the watershed will reduce the sediment load to the impaired stream to the required allocation. The first implementation milestone is to install three of the six detention ponds (*i.e.*, 50% of the implementation actions) within the first two years. Assuming a direct relationship between implementation and water quality, the first water quality milestone is an expected 15% reduction of the sediment load to the stream (50% of the 30% required) within the first two years.

7.1.3.2 Modeled Method

If modeling is used to evaluate milestones, water quality can be linked with specific levels of implementation. For example, in the fecal coliform TMDL IP for North Fork Blackwater River, South Fork Blackwater River, Upper Blackwater River, and Middle Blackwater River Watersheds, modeling of the watersheds showed that reduction of direct loads (*i.e.*, uncontrolled discharge, livestock in streams, and wildlife direct deposition) is critical to improving water quality. Therefore, the implementation actions selected to reduce the fecal coliform load to the streams were 100% livestock exclusion from the streams (*e.g.*, alternative water sources, fencing, hardened crossings) and replacement of all straight pipes with new septic systems (100% of straight pipes corrected). Stakeholders established that implementation would begin in July 2001 after which three water quality milestones needed to be met within the next ten years (Table 7.1). Using a watershed-scale loading model (HSPF) for the four watersheds, reductions in exceedances of the geometric mean water quality standard were estimated for each milestone. The first water quality milestone was set at two years after implementation begins, whereby 50% of the livestock exclusion systems and 100% of the residential implementation actions would be installed. Using the model, a 1% to 26% reduction in exceedances of the water quality standard is expected for the first water quality milestone.

7.1.3.3 Targeted Method

Using the Direct Method and the Modeled Method, installation of implementation actions is assumed to be uniform throughout the watershed. By “targeting” the critical areas in the watershed (the areas in the watershed with the greatest likelihood of impairment), the greatest impact in water quality can be achieved in the shortest amount of time. Targeting is proposed not only to ensure optimum utilization of revenue and resources but also to support a staged implementation approach. When using the Targeted

Method, stream walks, watershed inventory, analysis of land use, stream network GIS layers, monitoring results, and BMP survey responses can all be used in determining the critical areas for BMP installation.

Monitored data collected during the TMDL development process can be used together with spatial analysis results to target subwatersheds where initial implementation resources would result in the greatest return in water quality improvement. For example, in one of the IPs in Virginia (the Cedar, Hall/Byers, and Hutton Creek watersheds in Washington County) monitoring showed the greatest impact from human sources in the Hutton and Hall/Byers Creek watersheds. While it was recommended that efforts should be made to eliminate human sources of contamination in all three watersheds, initial efforts might best be focused in the upper reaches of the Hall/Byers and Hutton Creek watersheds.

Table 7.1 Implementation and water quality milestones (*i.e.*, estimation of fecal coliform geometric mean water quality standard exceedances) in North Fork Blackwater River, South Fork Blackwater River, Upper Blackwater River, and Middle Blackwater River watersheds

Milestone	Date	Implementation Milestone	Water Quality Milestone: fecal coliform geometric mean water quality standard exceedances			
			North Fork (%)	South Fork (%)	Upper (%)	Middle (%)
Existing	7/01/01	Implementation Begins	83	98	100	82
1	7/01/03	50% Livestock Exclusion Systems Installed, 100% Straight Pipe Corrected	74	79	99	61
2	7/01/06	100% Livestock Exclusion Systems Installed	0	3	6	2
3	7/01/11	De-listing from 303(d) List	0	0	0	0

If an assessment of the delivery mechanisms and pollutant sources is available, this information can be used to further target the relationship between water quality response and implementation actions and to establish milestones. Using the example of a general standard TMDL in an urban watershed in which sediment loads to the stream need to be reduced by 30% (described in Section 7.1.3.1), an implementation planning team has determined that one of six detention ponds to be installed in a watershed will impact 50% of the sediment load within the watershed, while the rest of the load will be impacted uniformly between the other five ponds ($50\% / 5 \text{ ponds} = 10\% / \text{pond}$). The team has decided that the first implementation milestone is to install three of the six detention ponds (50% of the implementation actions) within the first two years, with the indication that one of these will be the pond with the greatest impact. The first water quality milestone is an expected 21% reduction of the sediment load ($50\% + 10\% + 10\% = 70\%$ of the 30% required) within the first two years.

If modeling can be used for targeting, improvements in water quality can be evaluated by simulating various “targeting scenarios”. Placing implementation actions in more localized areas (instead of assuming a uniform distribution within the watershed) and then running the model for different scenarios can provide a more accurate estimate of the improvements in water quality.

For example, in the four Blackwater River watersheds, monitoring stations were located at three sites in the South Fork, three sites in the North Fork, three sites in the Upper Blackwater, and five sites in the Middle Blackwater, dividing the watersheds into a total of fourteen subwatersheds. Using this information, HSPF was used to model targeting scenarios in the fourteen subwatersheds. That is, the model was used to distribute the BMPs throughout the subwatersheds to determine in which subwatersheds the BMPs would have the greatest impact on reducing fecal coliform exceedances. By targeting distribution of the livestock exclusion systems, the geometric mean exceedances can be reduced by 6%, 16%, 50%, and 65% in Upper Blackwater River, South Fork Blackwater River, Middle Blackwater River, and North Fork Blackwater, respectively, compared to the 1%, 19%, 26%, and 11%, respectively, previously estimated without targeting subwatersheds. Recommendations were then made to first concentrate resources to the subwatersheds that have the greatest impact on fecal coliform reductions.

7.2 Establishing a Timeline for Implementation

Based on meeting the milestones, the IP needs to include a timeline that describes the annual goals for implementation in terms of implementation actions (*e.g.*, agricultural, urban, mining), and identifies technical assistance needs and total costs. The IP timeline needs to be developed based on the availability of human resources (stakeholder participation, contractors, technical assistance, *etc.*), funding resources, and regulatory requirements.

Tables 7.2 and 7.3 provide an example of the implementation timeline that was used in the North Fork Blackwater River, South Fork Blackwater River, Upper Blackwater River, and Middle Blackwater River Watersheds. Input from stakeholders, local governments, and local contractors were essential in creating the IP timeline. Potential funding sources available during implementation were identified during plan development and used to estimate the cost input for the timeline.

Table 7.2 Percentage of practices to be installed addressing livestock exclusion and straight pipes with amount of technical assistance needed in North Fork Blackwater River, South Fork Blackwater River, Upper Blackwater River, and Middle Blackwater River watersheds

Date (year)	Livestock Exclusion (%)	Straight Pipes (%)	Agricultural Technical Assistance		Residential Technical Assistance	
			<i>Technical</i> (FTE)	<i>Administrative</i> (FTE)	<i>Technical</i> (FTE)	<i>Administrative</i> (FTE)
1	25	50	3	1.5	0.5	0.25
2	25	50	3	1.5	0.5	0.25
3	17	0	3	1.5	0	0
4	17	0	3	1.5	0	0
5	16	0	3	1.5	0	0
<i>Total</i>	<i>100</i>	<i>100</i>	<i>18</i>	<i>7.5</i>	<i>1</i>	<i>0.5</i>

Table 7.3 Cost associated with percentage of practices installed addressing livestock exclusion, straight pipes and technical assistance needed in North Fork Blackwater River, South Fork Blackwater River, Upper Blackwater River, and Middle Blackwater River watersheds

Date (year)	Livestock Exclusion (\$)	Straight Pipes (\$)	Agricultural Technical Assistance		Residential Technical Assistance		Total Cost Per Year (\$)
			<i>Technical</i> (\$)	<i>Administrative</i> (\$)	<i>Technical</i> (\$)	<i>Administrative</i> (\$)	
1	938,000	40,000	150,000	53,000	25,000	9,000	1,215,000
2	938,000	40,000	150,000	53,000	25,000	9,000	1,215,000
3	638,000	0	150,000	53,000	0	0	841,000
4	638,000	0	150,000	53,000	0	0	841,000
5	600,000	0	150,000	53,000	0	0	803,000
<i>Total</i>	<i>3,752,000</i>	<i>80,000</i>	<i>750,000</i>	<i>265,000</i>	<i>50,000</i>	<i>18,000</i>	<i>4,915,000</i>

7.3 Reasonable Assurance

Public participation (Chapter 5) is an integral part of the IP development and is critical to promote reasonable assurances that the implementation activities will occur. During the public participation process, planners should be able to evaluate the willingness, to some degree, of the public to voluntarily participate in the implementation. For example, during development of the three existing IPs in Virginia, Agricultural Focus Group meetings, as well as other focus group meetings, were held for all three projects. Input from these meetings was used in the development of the IPs, providing reasonable assurance that the public was contributing to the TMDL process.

Likewise, stakeholder participation and support (Chapter 8) is essential for achieving the goals of this TMDL effort. By incorporating stakeholder input into the process, stakeholders will be able to express which BMP options they feel will be most effective in resolving water quality problems. Understanding the cultural issues of the stakeholders is important in obtaining reasonable assurance that BMPs will be implemented. For instance, some groups may be willing to voluntarily participate in implementation actions; however, they are reluctant to support programs sponsored or funded by the government. Having this information during IP development enables planners to provide BMP options that are most appropriate for the stakeholders in the watershed.

The IP should also detail the availability of funds and incentives for implementation of voluntary actions to provide reasonable assurance that TMDLs will be allocated and met. Potential sources of funding are offered in Chapter 10 of this manual.

7.4 Developing Tracking and Monitoring Plans

7.4.1 Implementation Tracking

Implementation actions should be tracked to ensure that BMPs are adequately installed and maintained. Implementation tracking inventories the locations of and the numbers of BMPs put into place within the watershed and will be used to evaluate changes in the watershed. BMP tracking units might include acres of land covered by implementation actions, the number of retention basins in place, or decreases in straight pipes to the streams within the watershed. Management measures, such as number of stakeholders participating in cost-share programs, and types of outreach education activities (*e.g.*, workshops, mailings, field days), should also be tracked. Examples of BMP tracking tools (government forms, Excel spreadsheets, GIS layers) that can be used in a tracking plan can be found in Appendix C.

7.4.2 Water Quality Monitoring

An appropriate monitoring plan addresses the schedule for and location of water quality monitoring, organization(s) responsible for monitoring, and what the monitoring procedure will be. If possible, monitoring should be conducted at the same sites as sites used during TMDL development to evaluate the change in water quality once

Elements to address when developing a MONITORING PLAN:

- site locations
- frequency
- parameters

Factors to consider when developing a MONITORING PLAN:

- monitoring programs currently in place
- available resources (*e.g.*, citizens monitoring)
- comparability to pre-implementation monitoring (*e.g.*, monitoring for same parameters at same locations)

Source: **Guidance for Developing Watershed-based Plans for Impaired Waters, Draft Outline**, EPA, 2002.

BMPs have been implemented. Also, monitoring should be conducted where needed to assess the effectiveness of targeting efforts.

Virginia's Water Quality Monitoring Strategy (draft) states that for bacteria TMDLs, the parameter of concern in freshwater streams will be *E. coli*. For benthic TMDLs, the assessment should focus on biological monitoring. Implementation monitoring will generally be the same as that done in TMDL development. However, modifications may be made to reflect the needs of the IP. DEQ and DCR TMDL staff will determine sites, frequency, and duration of the implementation monitoring.

7.4.2.1 Planning an effective monitoring strategy during TMDL Implementation Plan development

There are many things to consider when monitoring the success of the implementation and measuring water quality milestones. These may include:

- identifying sources of monitoring data (see above Sections 7.1.2.1 and 7.1.2.2 for more information on potential sources);
- matching parameters to be monitored with impairment. (For a bacterial impairment, water quality analysis should include the appropriate bacteria indicator, *e.g.*, *E. coli* enumerations. For a general standard (benthic) impairment, water quality analysis should include biological monitoring); and
- setting a timeline for achieving water quality milestones (Section 7.2).

7.5 Evaluation of Progress, Follow-up Actions if Water Quality Standards Are Not Attained

The IP should include a section defining the course of action as the implementation milestones and monitoring plan are reviewed. It is necessary to evaluate the progress of the IP on a regular basis in order to assess the effectiveness or unsuitability of the IP and to make adjustments as needed. Evaluation of progress includes evaluating the annual goals defined in the timeline and the milestones. Evaluation can occur on an annual basis to determine the effectiveness of the annual goals, and within an appropriate timeframe to assess the effectiveness of the milestones and the monitoring plan.

7.5.1 Water Quality Attained

If the monitoring process indicates that water quality standards are met, the next step is to de-list the water body. Delisting will occur as part of the regular statewide water quality assessment process documented in the biennial 305(b) report and following the established 305(b) guidance requirements. In some cases, for example when a large number of BMPs are implemented very rapidly, it may be possible to demonstrate attainment outside of the typical 5-year assessment period.

7.5.2 Water Quality Not Attained

As illustrated in Figure 7.1, a variety of scenarios can result during the implementation phase.

7.5.2.1 Implementation Milestones Met, Water Quality Milestones Met

If the monitoring process reveals that implementation milestones and water quality milestones are being met on schedule, then implementation and monitoring should continue as planned.

7.5.2.2 Implementation Milestones Met, Water Quality Milestones Not Met

In some cases, monitoring will reveal that implementation milestones are being met and yet water quality is not showing the expected improvements. This can mean that the TMDL or the IP need revision, greater lag time than anticipated between implementation of BMPs and their effectiveness, or that the TMDL may not be attainable even with the implementation of reasonable BMPs.

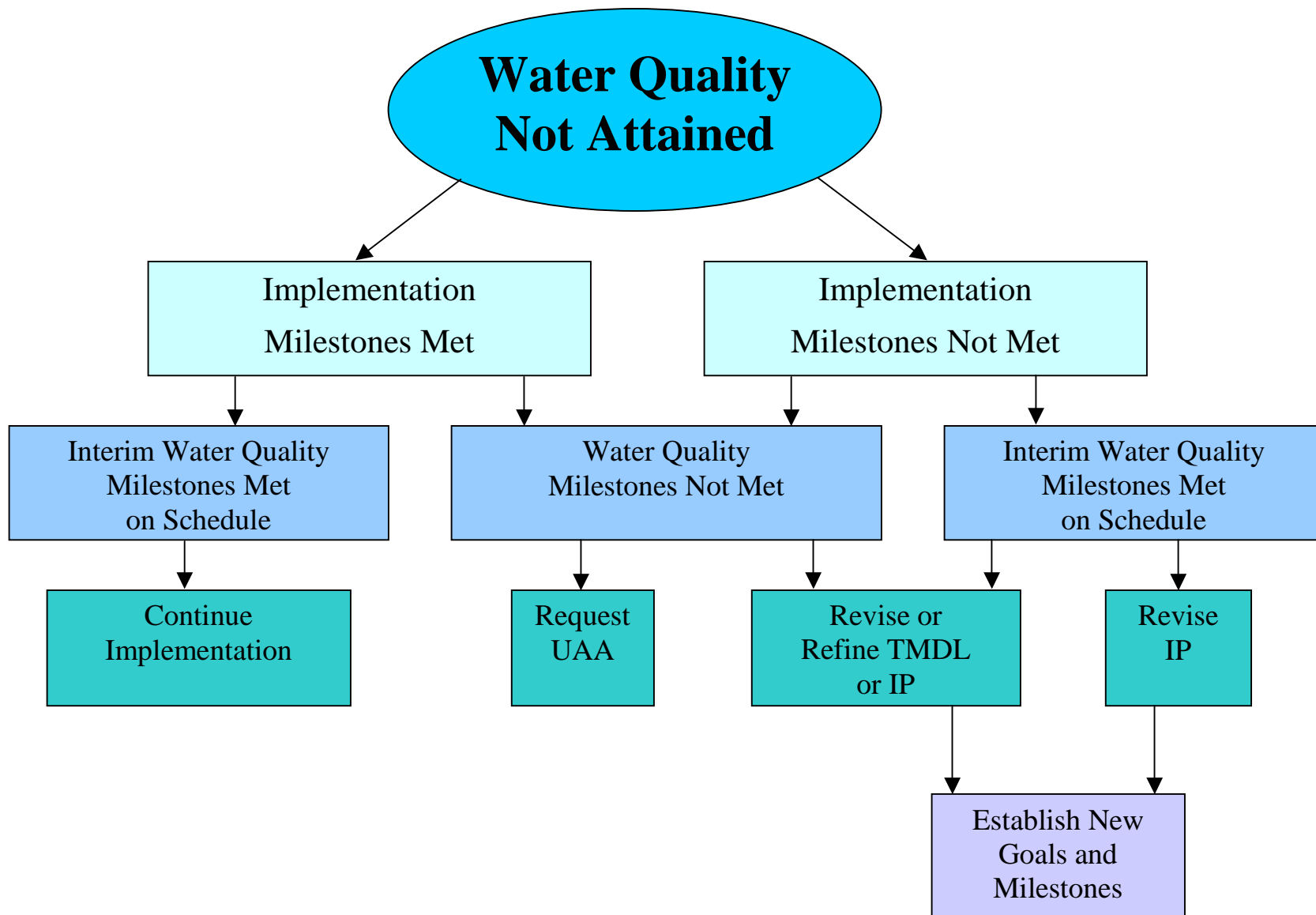


Figure 7.1 Follow-up actions if water quality standards are not met

If the established water quality milestones are far from being met, then it is necessary to consider revising the IP, the IP schedule, or the TMDL itself. If it is evident that the deterrents to progress are inherent to the IP (e.g., false assumptions made about stakeholder commitment, inappropriate selection of BMPs), then refinement of the IP is indicated. If it is determined that the IP is not at fault, consideration must be given to revision or refinement of the TMDL. When revising either the IP schedule or the TMDL itself, new goals and milestones are established and evaluation of progress would begin again. If there are indications that the TMDL may need to be revised, the regional DEQ TMDL Coordinator should be contacted.

If it is determined that the TMDL is not attainable even with the implementation of reasonable BMPs, a Use Attainability Analysis (UAA) may be necessary to re-classify the stream and its designated use. DEQ anticipates that UAAs would be appropriate only in selected cases. While many streams in the Commonwealth of Virginia are not used for recreational purposes, all waters have been designated as "primary contact recreation" for swimming use regardless of size, depth, location, water quality, or actual use. A UAA can result in a change of the beneficial use to "secondary contact recreation" with less stringent water quality for bacteria.

In some water bodies, populations of wildlife are so great that the natural condition alone is significant enough to exceed the water quality standards for bacteria. If monitoring during the implementation phase indicates that removal of the anthropogenic sources was not adequate to obtain the designated use, a UAA may result in a stream classified as wildlife-impacted for bacterial impairments. Additional information on the state's water quality standards can be found at www.deq.state.va.us/water.

7.5.2.3 Implementation Milestones Not Met, Water Quality Milestones Not Met

If neither the implementation nor the water quality milestones are being met as expected, it is critical to determine why. If deterrents to progress are due to external influences that are expected to be resolved (e.g., lack of funding, lag in stakeholder commitment) or to inappropriate selection of BMPs, then it may be appropriate to revise the IP schedule accordingly and establish new goals and milestones.

If monitoring reveals that the established milestones are far from being met, a revision of the TMDL may be indicated.

7.5.2.4 Implementation Milestones Not Met, Water Quality Milestones Met

It is possible to see improvements in water quality even when implementation milestones are not being met as planned. This could be due to BMPs having a greater effect than expected or to unpredictable causes. In these instances, the IP schedule can be revised to reflect the accelerated progress that is being made. New goals and milestones should then be established, and evaluation of progress should continue.

8.0 STAKEHOLDERS' ROLES AND RESPONSIBILITIES

(The language included in this section may be inserted into the Stakeholders' section of the Implementation Plan, or it may be modified to meet the needs of the group developing the Plan.)

Stakeholders are individuals who live or have land management responsibilities in the watershed, including government agencies, businesses,

The STAKEHOLDERS' ROLES AND RESPONSIBILITIES chapter of the Implementation Plan should address the following questions:

- Who are the stakeholders identified in the TMDL development process?
- Which stakeholders have not yet been engaged?
- Which stakeholders will assist in implementing the IP?
- What will be the specific roles and responsibilities of the stakeholders?
- What resources can the stakeholders provide toward implementation?
- Which stakeholders are involved in voluntary controls?
- Which stakeholders are involved in regulatory controls?

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private individuals and special interest groups. Stakeholder participation and support is essential for achieving the goals of this TMDL effort (*i.e.*, improving water quality and removing streams from the impaired waters list). The purpose of this chapter is to identify and define the roles of the stakeholders who will work together to develop the IP.

The roles and responsibilities of some of the major stakeholders are described below.

8.1 Federal Government

U.S. Environmental Protection Agency (EPA): EPA has the responsibility of overseeing the various programs necessary for the success of the Clean Water Act. However, administration and enforcement of such programs falls largely to the states.

U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS): NRCS is the federal agency that works hand-in-hand with the American people to conserve natural resources on private lands. NRCS assists private landowners with conserving their soil, water, and other natural resources. Local, state and federal agencies and policymakers also rely on the expertise on NRCS staff. NRCS is also a major funding stakeholder for impaired water bodies through the Conservation Reserve Enhancement Program (CREP) and the Environmental Quality Incentive Program (EQIP). For more information on NRCS, visit <http://www.nrcs.usda.gov/>.

8.2 State Government

In the Commonwealth of Virginia, water quality problems are dealt with through legislation, incentive programs, education, and legal actions. Currently, there are five state agencies responsible for regulating and/or overseeing statewide activities that impact water quality in Virginia. These agencies include: DEQ,

DCR, Virginia Department of Agriculture and Consumer Services (VDACS), VDH, the Virginia Department of Forestry (DOF), and VCE.

DEQ: The State Water Control Law authorizes the State Water Control Board to control and plan for the reduction of pollutants impacting the chemical and biological quality of the State's waters resulting in the degradation of the swimming, fishing, shell fishing, aquatic life, and drinking water uses. For many years the focus of DEQ's pollution reduction efforts was the treated effluent discharged into Virginia's waters via the VPDES permit process. The TMDL process has expanded the focus of DEQ's pollution reduction efforts from the effluent of wastewater treatment plants to the pollutants causing impairments of the streams, lakes, and estuaries. The reduction tools are being expanded beyond the permit process to include a variety of voluntary strategies and BMPs.

DEQ is the lead agency in the TMDL process. The Code of Virginia directs DEQ to develop a list of impaired waters, develop TMDLs for these waters, and develop IPs for the TMDLs. DEQ administers the TMDL process, including the public participation component, and formally submits the TMDLs to EPA and the State Water Control Board for approval. DEQ is also responsible for implementing point source WLAs, assessing water quality across the state, and conducting water quality standard related actions.

DCR: DCR is authorized to administer Virginia's NPS pollution reduction programs in accordance with §10.1-104.1 of the Code of Virginia and §319 of the Clean Water Act. EPA is requiring that much of the §319 grant monies be used for the development of TMDLs.

Because of the magnitude of the NPS component in the TMDL process, DCR is a major participant the TMDL process. DCR has a lead role in the development of IPs to address correction of NPSs contributing to water quality impairments. DCR also provides available funding and technical support for the implementation of NPS components of IPs. The staff resources in DCR's TMDL program focus primarily on providing technical assistance and funding to stakeholders to develop and carry out IPs, and support to DEQ in TMDL development related to NPS impacts. DCR staff will also be working with other state agencies, Soil and Water Conservation Districts, and watershed groups to gather support and to improve the implementation of TMDL plans through utilization of existing authorities and resources.

VDACS: The VDACS Commissioner of Agriculture has the authority to investigate claims that an agricultural producer is causing a water quality problem on a case-by-case basis (Pugh, 2001). If deemed a problem, the Commissioner can order the producer to submit an agricultural stewardship plan to the local soil and water conservation district. If a producer fails to implement the plan, corrective action can be taken, which may include civil penalties. The Commissioner of Agriculture can issue an emergency corrective action if runoff is likely to endanger public health, animals, fish and aquatic life, public water supply, *etc.* An emergency order can shut down all or part of an agricultural activity and require specific stewardship measures.

VDH: The VDH is responsible for maintaining safe drinking water measured by standards set by the EPA. Their duties also include septic system regulation and regulation of biosolids land application. Like VDACS, VDH is complaint driven. Complaints can range from a vent pipe odor that is not an actual sewage violation and takes very little time to investigate, to a large discharge violation that may take many weeks or longer to effect compliance. For TMDLs, VDH has the responsibility of enforcing actions to correct failed septic systems and/or eliminate straight pipes (Sewage Handling and Disposal Regulations, 12 VAC 5-610-10 *et seq.*).

DOF: The DOF has prepared a manual to inform and educate forest landowners and the professional forest community on proper BMPs and technical specifications for installation of these practices in forested areas (<http://www.dof.state.va.us/wq/wq-bmp-guide.htm>). Forestry BMPs are directed primarily to control erosion. For example, streamside forest buffers provide nutrient uptake and soil stabilization, which can benefit water quality by reducing the amount of nutrients and sediments that enter local streams.

Although the DOF's BMP program is intended to be voluntary, it becomes mandatory for any silvicultural operation occurring within a Chesapeake Bay Preservation Area (Chesapeake Bay Preservation Area Designation and Management Regulations, 9VAC10-20 et seq.). For more information on this regulation, visit <http://www.dof.state.va.us/resources/wq-BMP-Chapter-10.pdf>.

VCE: VCE is an educational outreach program of Virginia's land grant universities (Virginia Tech and Virginia State University), and a part of the national Cooperative State Research, Education, and Extension Service, an agency of the United States Department of Agriculture. VCE is a product of cooperation among local, state, and federal governments in partnership with citizens. VCE offers educational programs and technical resources for topics such as crops, grains, livestock, poultry, dairy, natural resources, and environmental management. VCE has published several publications that deal specifically with TMDLs. For more information on these publications and to find the location of county extension offices, visit www.ext.vt.edu.

8.3 Local Government

Local government groups work closely with state and federal agencies throughout the TMDL process; these groups possess insights about their community that may help to ensure the success of TMDL implementation. These stakeholders have knowledge about a community's priorities, how decisions are made locally, and how the watershed's residents interact. Some local government groups and their roles in the TMDL process are listed below.

SWCDs: SWCDs are local units of government responsible for the soil and water conservation work within their boundaries. The districts' role is to increase voluntary conservation practices among farmers, ranchers and other land users. District staff work closely with watershed residents and have valuable knowledge of local watershed practices.

PDCs: PDCs were organized to promote the efficient development of the environment by assisting and encouraging local governmental agencies to plan for the future. PDCs focus much of their efforts on water quality planning, which is complementary to the TMDL process. TMDL development and implementation projects are often contracted through PDCs. For more information on the PDCs located in Virginia, please visit <http://www.institute.virginia.edu/vapdc/>.

County/City Government Departments: City and county government staff work closely with PDCs and state agencies to develop and implement TMDLs. They may also help to promote education and outreach to citizens, businesses and developers to introduce the importance of the TMDL process.

8.4 Businesses, Community Groups, and Citizens

While successful implementation depends on stakeholders taking responsibility for their role in the process, the primary role falls on the local groups that are most affected; that is, businesses, community watershed groups, and citizens.

Community Watershed Groups: Local watershed groups offer a meeting place for river groups to share ideas and coordinate preservation efforts and are also a showcase site for citizen action. Watershed groups also have a valuable knowledge of the local watershed and river habitat that is important to the implementation process.

Citizens and Businesses: The primary role of citizens and businesses is simply to get involved in the TMDL process. This may include participating in public meetings (Section 5.1), assisting with public outreach, providing input about the local watershed history, and/or implementing best management practices to help restore water quality.

Community Civic Groups - Community civic groups take on a wide range of community service including environmental projects. Such groups include Ruritan, Farm Clubs, Homeowner Associations and youth organizations such as 4-H and Future Farmers of America. These groups offer a resource to assist in the public participation process, educational outreach, and assisting with implementation activities in local watersheds.

Animal Clubs/Associations – Clubs and associations for various animal groups (*e.g.*, beef, equine, poultry, swine, and canine) provide a resource to assist and promote conservation practices among farmers and other land owners, not only in rural areas, but in urban areas as well, where pet waste has been identified as a source of bacteria in water bodies.

Virginia's approach to correcting non-point source pollution problems continues to be encouragement of participation through education and financial incentives; that is, outside of the regulatory framework. If, however, voluntary approaches prove to be ineffective, it is likely that implementation will become less voluntary and more regulatory.

The benefits of involving the public in the implementation process are potentially very rewarding, but the process of doing so can be incredibly challenging. It is, therefore, the primary responsibility of these stakeholder groups to work with the various state agencies to encourage public participation and assure broad representation and objectivity throughout the IP development process.

9.0 INTEGRATION WITH OTHER WATERSHED PLANS

Each watershed within the state is under the jurisdiction of a multitude of individual yet related water quality programs and activities, many of

Things to consider in integrating multiple watershed plans:

- What other watershed or WQMPs exists or are being developed that should be considered in preparing a TMDL IP?
- How are the goals and objectives of these plans different from the TMDL (*e.g.*, TMDLs are pollutant specific)?
- Which of the required components of a TMDL IP do these plans address or partially address?
- Can financial and technical resources be maximized for TMDL implementation by coordinating and expanding the planning and implementation activities of on-going watershed projects or programs?
- If watershed-planning activities are non-existent, should the TMDL IP be developed for the entire watershed and not just for the impaired stream segments?
- Are there other impaired water bodies in the watershed that have a TMDL scheduled? When will the other TMDL(s) be completed and approved?

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which have specific geographical boundaries and goals. These include but are not limited to, the Chesapeake Bay 2000 agreement, Tributary Nutrient Reduction Plans, coastal management plans, Total Maximum Daily Loads, roundtables, WQMPs, sediment and erosion control regulations, stormwater management (SWM), Source Water Assessment Program (SWAP), local comprehensive plans, and much more. In some cases, an IP may even address multiple TMDLs (*e.g.*, bacteria and benthic) for the same impaired water body.

9.1 Continuing Planning Process

According to Perciasepe (1997) the continuing planning process (CPP) established by Section 303(e) of the Clean Water Act provides a good framework for implementing TMDLs, especially the NPS load allocations. Under the Section 303(e) process, states develop and update statewide plans that include TMDL development and adequate implementation of new and revised water quality standards, among other components. The water quality management regulations at 40 CFR 130.6 require states to maintain WQMPs that are used to direct implementation of key elements of the continuing planning process, including TMDLs, effluent limitations, and NPS management controls. These state WQMPs are another way for states to describe how they will achieve TMDL load allocations for NPSs.

The CPP in Virginia is implemented in various state programs, all aimed toward achieving and maintaining the state water quality standards. Virginia Code Sections 62.1-44.15(10) & (13), 62.1-44.17:3, and 62.1-44.19:7 give the Virginia State Water Control Board (Board) the duty and authority to conduct the CPP in Virginia. Under the authority of Virginia Code Section 10.1-1183, DEQ serves as the administration arm of the Board.

Virginia WQMPs consist of initial plans produced in accordance with Sections 208 and 303(e) of the CWA and approved updates to the plans. Currently, Virginia has a total 18 WQMPs developed under Sections 208 and 303(e). Many of these plans are outdated, and efforts are underway to update them. The updated plans will serve as repository for all TMDLs that have been approved by EPA and adopted by the Board, and also for IPs approved by the Board.

9.2 Watershed and Water Quality Management Planning Programs in Virginia

- Chesapeake 2000 Agreement – Watershed Management Planning - Commitment calls for two-thirds of the Bay watershed to be covered by locally supported watershed management plans by 2010 to address the protection, conservation and restoration of stream corridors, riparian forest buffers, and wetlands for the purpose of improving habitat and water quality. Watershed plans will be developed and implemented by local governments, community groups and watershed organizations. DCR is in the process of developing a Small-Watershed Planning Guide that will reference the coordination of TMDL implementation planning.
- Chesapeake Bay Tributary Nutrient Reduction Plans – Virginia has worked to develop and implement water quality plans since the early 1990s for each major tributary to the Bay, as well as for smaller creeks of the state’s Eastern Shore. These plans address the reduction of nutrients and sediment that have been identified to be the greatest water quality problem faced by the Chesapeake Bay. These plans are cooperative rather than regulatory and were designed to achieve equity among point sources of nutrients and NPSs. These strategies will be revised beginning in April 2003 to address new pollutant load reductions for each of the tributaries. The modified load reductions are necessary because new water quality standards are being adopted for the Bay (for more information on Virginia tributary strategies, visit www.deq.state.va.us/bay/strategies.html).
- Coastal Management Plans – One of the purposes of the Virginia Coastal Program is to encourage the preparation of special management plans to provide increased specificity in protecting significant natural resources, reasonable coastal-dependent economic growth, improved protection of life and property in hazardous areas, and improved predictability in governmental decision-making.
- TMDLs – TMDLs are the maximum amount of pollutant that a water body can assimilate without surpassing state water quality standards. TMDLs are developed for water bodies that are listed on a state’s 303(d) list, known as the “Impaired Waters List.” The TMDL develops a waste load allocation for point sources and a load allocation for NPSs and incorporates a “margin of safety” in defining the assimilation capacity of the water body. The IP outlines strategies to meet the allocations.
- River Roundtables – 501c (3) non-profit organizations working to achieve clean water by involving citizens in planning, education, coordination, attracting funding and serving as advocates for water resources.
- WQMPs – WQMPs are produced and updated by DEQ in accordance with Sections 208 and 303(e) of the CWA as outlined in the CPP section above. These plans will be the repository for TMDLs and TMDL IPs.

- Sediment and Erosion Control Regulations – DCR implements the state Erosion and Sediment Control (ESC) Program according to the *Virginia Erosion and Sediment Control Law, Regulations, and Certification Regulations* (VESCL&R). The ESC Program’s goal is to control soil erosion, sedimentation, and nonagricultural runoff from regulated “land-disturbing activities” to prevent degradation of property and natural resources. The regulations specify “Minimum Standards,” which include criteria, techniques and policies that must be followed on all regulated activities. These statutes delineate the rights and responsibilities of governments that administer a local ESC program and those of property owners who must comply. For more information, visit <http://www.dcr.state.va.us/sw/e&s.htm>.
- SWM – SWM programs are implemented according to the *Stormwater Management Law and Virginia Stormwater Management Regulations* (VSWML&R). These statutes are specifically set forth regarding land development activities to prevent water pollution, stream channel erosion, depletion of ground water resources, and more frequent localized flooding to protect property values and natural resources. SWM programs operated according to the law are designed to address these adverse impacts and comprehensively manage the quality and quantity of stormwater runoff on a watershed-wide basis. DCR oversees regulated activities undertaken on state and federal property, while localities have the option to establish a local program to regulate these same activities on private property in their jurisdiction. For more information, visit <http://www.dcr.state.va.us/sw/stormwat.htm>.
- Municipal Separate Storm Sewer Systems (MS4) Permits, Phase I and II – The Storm Water Phase I Rule (55 FR 47990; November 16, 1990) requires all operators of medium and large municipal separate storm sewer systems (MS4s) located in incorporated places or counties with populations of 100,000 or more to: 1) obtain a NPDES permit and 2) develop a storm water management program designed to prevent harmful pollutants from being washed by storm water into the storm sewer, then discharged from the storm sewer into local water bodies. The Phase II Final Rule published in the Federal Register on December 8, 1999 requires NPDES permit coverage from certain regulated small municipal storm sewer systems. For more information, visit <http://www.epa.gov/OWM>.
- SWAP – Section 1453 of the 1986 Amendments of the Safe Drinking Water Act (SDWA) requires each state to develop a SWAP that will delineate the boundaries of the assessment areas from which public water systems receive drinking water using hydrogeologic information, water flow, recharge, and discharge and other reliable information. VDH is the primary agency for drinking water and is therefore responsible for SWAP. In Virginia, all 187 surface water intakes serving 151 public waterworks have their surface water assessments completed. All 4,700 ground water sources serving nearly 4,000 public waterworks are scheduled to be completed by the end of March 2003.
- Local Comprehensive Plans – Virginia state law requires that all local governments have an adopted comprehensive plan. Typical topics addressed in a comprehensive plan include the analysis of population change, land use and trends, natural and environmental features, transportation systems, and community facilities and services. Local comprehensive plans should be referred to in the TMDL development process as well as TMDL implementation, especially the latter for urbanized watersheds.

10.0 POTENTIAL FUNDING SOURCES

Potential funding sources available for implementation should be identified in the IP. A more detailed description of each source can be obtained from the various websites of the local, state, and federal agencies that are identified in this guidance manual. Each of the sources has specific requirements and benefits that will vary in applicability to specific circumstances. Sources include, but are not limited to:

State

Virginia Agricultural Best Management Practices Cost-Share Program
Virginia Agricultural Best Management Practices Tax Credit Program
Virginia Agricultural Best Management Practices Loan Program
Virginia Forest Stewardship Program
Virginia Small Business Environmental Assistance Fund Loan Program

Federal

EPA 319 Funds
USDA Conservation Reserve Program (CRP)
USDA Conservation Reserve Enhancement Program (CREP)
USDA Environmental Quality Incentives Program (EQIP)
USDA Forest Incentive Program (FIP)
USDA Watershed and River Basin Planning and Installation Public Law 83-566 (PL566)
USDA Wildlife Habitat Incentive Program (WHIP)
USDA Wetland Reserve Program (WRP)
US Fish and Wildlife Service Private Stewardship Program
US Fish and Wildlife Service Conservation Grants

Local or Regional

Southeast Rural Community Assistance Project (Southeast RCAP)
Chesapeake Bay Small Watershed Grants Program

Landowner Contributions and Matching Funds

The Virginia and federal cost-share assistance programs require a cost-share match, which is generally 25%.

Private Foundations, Non-Profit Organizations, Businesses

National Fish and Wildlife Foundation

In the identification of the applicable funding sources for implementation of a TMDL, one must consider the types of BMPs that are necessary for the various land uses (agriculture, residential) in order to reduce the pollutant sources identified in the TMDL. Based on this analysis, potential funding sources can be identified in the IP that would address the watershed conditions. In identifying funding sources,

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consideration should be given to which sources are only available as grants and which project sponsor(s) may apply for the grant such as a government agency or watershed group. Most of the sources listed above are sources of funding for individual landowners, which are made available through traditional soil and water conservation programs.

10.1 Descriptions of Potential Funding Sources

State

- Virginia Agricultural Best Management Practices Cost-Share Program – The Program is administered by DCR to improve water quality in the state’s streams, rivers and the Chesapeake Bay. The basis of the program is to encourage the voluntary installation of agricultural best management practices to meet Virginia’s NPS pollution water quality objectives. This program is funded by the state Water Quality Improvement Fund and the federal Chesapeake Bay Program Implementation Grant monies through local SWCDs.
<http://www.dcr.state.va.us/sw/docs/bmpsbro2.pdf>
- Virginia Agricultural Best Management Practices Tax Credit Program – The program provides a tax credit for approved agricultural BMPs that are installed to improve water quality in accordance with a conservation plan approved by the local SWCD. The goal of this program is to encourage voluntary installation of BMPs that will address Virginia’s NPS pollution water quality objectives.
<http://www.dcr.state.va.us/sw/docs/bmpsbro2.pdf>
- Virginia Agricultural Best Management Practices Loan Program – The program offers a source of low interest financing to encourage the use of specific BMPs to reduce or eliminate the impact of agricultural NPS pollution on Virginia’s waters. The minimum allowable loan amount is \$5,000 and the repayment periods may range from one to ten years. DEQ administers this program.
<http://www.deq.state.va.us/cap/aghome.html>
- Virginia Forest Stewardship Program - The program is administered by the DOF to protect soil, water, and wildlife and to provide sustainable forest products and recreation.
http://www.vdof.org/resources/f127_po.pdf
- Virginia Small Business Environmental Compliance Assistance Fund – The program provides financial assistance to small businesses by providing loans for the installation of agricultural BMPs certified as eligible by DCR. Interest rates are fixed at 3%, and the maximum loan available is \$100,000. <http://www.dba.state.va.us/financing/programs/small.asp>

Federal

- EPA 319 Funds – EPA develops guidelines that describe the process and criteria to be used to award Clean Water Act Section 319 NPS grants to states. States may use up to 20% of the Section 319 incremental funds to develop NPS TMDLs as well as to develop watershed-based plans for Section 303(d) listed waters. The balance of funding can be used for implementing watershed-based plans for waters that have completed TMDLs. Implementation of both agricultural and residential BMPs is eligible. <http://www.epa.gov/owow/nps/319/319stateguide-revised.pdf>
- Conservation Reserve Program (CRP) – The program offers annual rental payments, incentive payments for certain activities, and cost-share assistance to establish approved cover on cropland.

Contract duration is between 10 and 15 years, and cost-share assistance is provided up to 50% of costs. <http://www.nrcs.usda.gov/programs/crp/>

- Conservation Reserve Enhancement Program (CREP) – In Virginia, this is a partnership program between the USDA and the Commonwealth of Virginia, with the DCR being the lead state agency. The program uses financial incentives to encourage farmers to enroll in contracts of 10 to 15 years or perpetual easements to remove lands from agricultural production. <http://www.dcr.state.va.us/sw/crep.htm>
- Environmental Quality Incentives Program (EQIP) - The purposes of the program are achieved through the implementation of an EQIP plan of operation, which includes structural and land management practices on eligible lands. Contracts up to ten years are written with eligible producers. Cost-share is made available to implement one or more eligible conservation practices, such as animal waste management facilities, terraces, filter strips, tree planting, and permanent wildlife habitat. Incentive payments can be made to implement one or more management practices, such as nutrient management, pest management, and grazing land management. <http://www.nrcs.usda.gov/programs/eqip/>
- Forestry Incentives Program (FIP) – The purpose of this program is to encourage development, management, and protection of private forestland. <http://www.nrcs.usda.gov/programs/fip/>
- Small Watershed Program and Flood Prevention Program (Public Law 83-566) – The purpose of this program is to assist federal, state, local agencies, local government sponsors, tribal governments, and program participants to protect watersheds from damage caused by erosion, floodwater, and sediment, to conserve and develop water and land resources; and to solve natural resource and related economic problems on a watershed basis. The program empowers local people or decision makers, builds partnerships, and requires local and state funding contributions. Both technical and financial assistance is available for watersheds not exceeding 250,000 acres. <http://www.nrcs.usda.gov/programs/watershed/index.html>
- Wetlands Reserve Program (WRP) – The program provides an opportunity for landowners to receive financial incentives to enhance wetlands in exchange for retiring marginal lands from agriculture. The program offers three enrollment options: permanent easements, 30-year easement, and restoration cost-share agreement (10-year agreement where USDA pays 75% of the restoration costs). <http://www.nrcs.usda.gov/programs/wrp/>
- Wildlife Habitat Incentives Program (WHIP) - USDA and the participant enter into a five to ten year cost-share agreement for wildlife habitat development. Cost-share up to 75% is available for the cost of installing practices. <http://www.nrcs.usda.gov/programs/whip/>
- U.S. Fish and Wildlife Service Private Stewardship Program – Funds individuals or groups engaged in local, private, and voluntary conservation efforts to benefit federally listed, proposed, or candidate species, or other at risk species. http://endangered.fws.gov/grants/private_stewardship.html
- U.S. Fish and Wildlife Service Conservation Grants – Funds states to implement conservation projects to protect federally listed threatened or endangered species and species at risk. <http://grants.fws.gov/state.html>

Local or Regional

- Southeast Rural Community Assistance Project (Southeast RCAP) - This project offers seed grants and loans for upgrades and new construction of water/wastewater projects. <http://www.sercap.org>
- Chesapeake Bay Small Watershed Grants Program - Partnership between the EPA Chesapeake Bay Program and the National Fish and Wildlife Foundation that provides grants to organizations working on a local level to protect and improve watersheds in the Chesapeake Bay basin, while building citizen-based resource stewardship. <http://www.nfwf.org/chesapeake/index.htm>

Private Foundations, Non-Profit Organizations, Businesses

- National Fish and Wildlife Foundation – Private, non-profit 501c(3) tax-exempt organization that fosters cooperative partnerships to conserve wildlife, plants, and the habitats on which they depend. A General Challenge Grants Program and a Special Grants Program are offered. Grants are available to federal, state, and local governments, educational institutions, and non-profit organizations through General Challenge Grants. Of particular interest is the Special Grant – Southern Rivers Conservation whereby on-the-ground projects are eligible to restore and enhance riparian and riverine habitat in twelve southeastern states, including Virginia. Stream restoration activities are eligible through this grant program. http://www.nfwf.org/programs/grant_apply.htm

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Glossary

Alternative waste treatment system—Any system for treatment of residential wastewater for return to the environment, other than a standard onsite septic system.

Bacterial Source Tracking (BST) — A collection of scientific methods used to track sources of fecal contamination.

Benthic— Refers to material, especially sediment, at the bottom of an aquatic ecosystem. It can be used to describe the organisms that live on, or in, the bottom of a water body.

Best Management Practices (BMPs) — Methods, measures or practices determined to be reasonable and cost-effective means for a landowner to meet certain, generally nonpoint source, pollution control needs. BMPs include structural and nonstructural controls and operation and maintenance procedures.

Compliance schedule— Schedules that are issued to allow permittees to construct treatment systems needed to meet permit limits. Compliance schedules are also sometimes required when permit limits have been violated and time is needed to correct the problems causing the violation(s). They are also required when new water quality-based effluent limits are established which require more treatment than can be achieved within a permit cycle.

Cost-share program — A program that allocates project funds to pay a percentage of the cost of constructing or implementing a best management practice. The remaining costs are paid by the producer(s).

Discharge — Flow of surface water in a stream or canal, or the outflow of groundwater from a flowing artesian well, ditch or spring. Can also apply to discharge of liquid effluent from a facility or to chemical emissions into the air through designated venting systems.

Effluent — Municipal sewage or industrial liquid waste (untreated, partially treated, or completely treated) that flows out of a treatment plant, septic system, pipe, *etc.*

Fecal coliform — Indicator organisms (organisms indicating presence of pathogens) associated with the digestive tract of warm-blooded animals.

Fixed-frequency water quality monitoring — Collecting water samples from a fixed location over time at regular intervals (*e.g.*, bi-monthly, monthly, annually.)

Full time equivalent (FTE) — FTE is calculated by dividing the total number of paid hours by the number of hours in a time period.

GIS (Geographic Information System) — Computer programs linking features commonly seen on maps (such as roads, town boundaries, water bodies) with related information not usually presented on maps, such as type of road surface, population, type of agriculture, type of vegetation, or water quality information. A GIS is a unique information system in which individual observations can be spatially referenced to each other.

Hardened crossing — A stabilized area (*e.g.*, concrete or wooden bridge) that provides access to and/or across a stream for livestock and/or farm machinery.

HSPF (Hydrologic Simulation Program – Fortran) — A computer simulation tool used to mathematically model nonpoint source pollution sources and movement of pollutants in a watershed.

Hydrography — The variation of stage (depth) or discharge in a stream over a period of time.

Load allocation (LA) — The portion of a receiving water's loading capacity attributed either to one of its existing or future nonpoint sources of pollution or to natural background sources. Load allocations are best estimates of the loading, which can range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading. Wherever possible, natural and nonpoint source loads should be distinguished.

Loading capacity (LC) — The greatest amount of loading a water body can receive without violating water quality standards.

Modeling — A system of mathematical expressions that describe the spatial and temporal distribution of water quality constituents resulting from fluid transport and the one or more individual processes and interactions within some prototype aquatic ecosystem.

Monitoring — Periodic or continuous surveillance to determine the pollutant levels in water bodies.

Nonpoint source — Pollution that originates from multiple sources over a relatively large area. Nonpoint sources can be divided into source activities related to either land or water use including failing septic tanks, improper animal-keeping practices, mining practices, forest practices, and urban and rural runoff.

Nutrient — Any substance assimilated by living things that promotes growth. The term is generally applied to nitrogen and phosphorus in wastewater, but is also applied to other essential and trace elements.

Pathogens — Microorganisms (*e.g.*, bacteria, viruses or parasites) that can cause disease in humans, animals, and plants.

Point source — Pollutant loads discharged at a specific location from pipes, outfalls, and conveyance channels from either municipal wastewater treatment plants or industrial treatment facilities or any conveyance such as a ditch, tunnel, conduit or pipe from which pollutants are discharged. Point sources have a single point of entry with a direct path to a water body. Point sources can also include pollutant loads contributed by tributaries to the main receiving water stream or river.

Riparian areas — Areas bordering streams, lakes, rivers and other watercourses. These areas have high water tables and support plants that require saturated soils during all or part of the year. Riparian areas include both wetland and upland zones.

Runoff — That part of precipitation, snowmelt, or irrigation water that runs off the land into streams or other surface water. It can carry pollutants from the air and land into receiving waters.

SL6 Grazing Land Protection Systems — A structural and/or management practice that will enhance or protect vegetative cover to reduce runoff of sediment and nutrients from existing pastureland, and reduce NPS pollution associated with grazing livestock.

Stakeholder — Any person with a vested interest in the TMDL development, *e.g.*, farmer, landowner, resident, business owner, or special interest group.

Storm-event water quality monitoring — Collecting water samples from a location during and/or immediately following a rainstorm.

Straight pipe — Delivers wastewater directly from a building (*e.g.*, house or milking parlor) to a stream, pond, lake or river.

TMDL (Total Maximum Daily Load) -- The sum of individual waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources and natural background, plus a Margin of Safety (MOS). TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures that relate to a state's water quality standard.

Waste load allocation (WLA) — The portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality-based effluent limitation (40CFR 130.2(h)).

Watershed — A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

Appendix A

Surveys

Watershed Survey—Agricultural Areas (Pleasant Run and Mill Creek)

The **Rockingham County Farm Bureau** requests this information as part of its effort to help the agricultural community meet the total maximum daily load (TMDL) requirements in the Mill Creek and Pleasant Run watersheds. Although the survey will be anonymous, we do ask that you specify the sub-watershed that your land is in to allow us to accurately target areas where resources might be needed.

Indicate your response with a ☐ or ☐ in appropriate box

FARM SIZE (Include rented acres): 50 Acres or less 51 to 100 acres More than 100 acres
Does a stream run through your property? yes no
TYPE OF OPERATION (Check all that apply): Dairy Beef Poultry Sheep Swine Other

MANAGEMENT PRACTICES

The source(s) of water for my livestock include: Pond Trough Stream Developed Spring Other

Which of the following practices have you implemented since 1997?

Stream fencing	Alternative water	Stormwater control (put a roof over a loafing lot, etc.)
Hardened water crossing	Conservation tillage	Other _____
Grass filter strips	Contour strip-cropping	
Manure storage	Upgraded a septic system	

If none, do you plan on putting in some new practices soon? yes no

NUTRIENT MANAGEMENT

Do you have manure storage? yes no
If yes, what type of storage: Dry Stack Site Dry Stack Structure Liquid Pit or Structure
If yes, what type of waste is being stored? Dairy Beef Poultry Sheep Swine Other
Storage capacity of site/structure: Less than 4 Months 4 - 6 Months More than 6 Months
Do you scrape and haul daily? yes no
Do you currently have a Nutrient Management Plan? yes no
Do you land-apply manure or other biosolids? yes no
If yes, approximately how much do you apply per year? _____ tons/acre or _____ gals/acre
When do you spread (circle all that apply)? Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Did you ever calibrate your manure spreader? yes no
Have you ever had your agricultural manures analyzed for nutrient values? yes no
Do you receive biosolids from elsewhere in the community for land application on your farm? yes no
If yes, how often? _____ **How much each time?** _____ **Where are the biosolids from?** _____

FERTILIZER Type used:

Organic (manure, compost) Inorganic (ammonia, phosphate) Combination = Organic__% and Inorganic__%

DAIRY: Total number of dairy animals: Cows _____ Heifers _____

Number of cows milked: _____

Average size of milk cows: 750-1,000 Lbs. 1,000-1,250 Lbs. 1,250-1,500 Lbs.

POULTRY: Type: Broilers Turkey Hens Turkey Toms Turkey Breeders Broiler Breeders Other

Number of Birds/Flock: _____ **Number of Flocks/Year:** _____

Type of dead bird disposal: Incineration Composting In-Ground Burial Rendering

BEEF: Total number of animals: _____

Type of operation: Cow/calf Feeder calves Finishing

SWINE: Total number of animals: _____

Type of Operation: Farrow to Finish Farrowing Finishing

SHEEP: Total number of animals: _____

Type of Operation: Ewe & Lamb Feeding Finishing Other

HORSES: Total number of animals: _____

OTHER: _____

HUMAN WASTE DISPOSAL

Type of system installed: Septic Sand System Package Treatment System Privy Community Sewer

Number of people served by your system on an average day: 1-2 3-5 6-10 11-20 Over 20

Has the septic tank been pumped within the past 5 years? yes no If not, when? _____

When was the system installed? (if known) _____ Has it ever failed? yes no I don't know

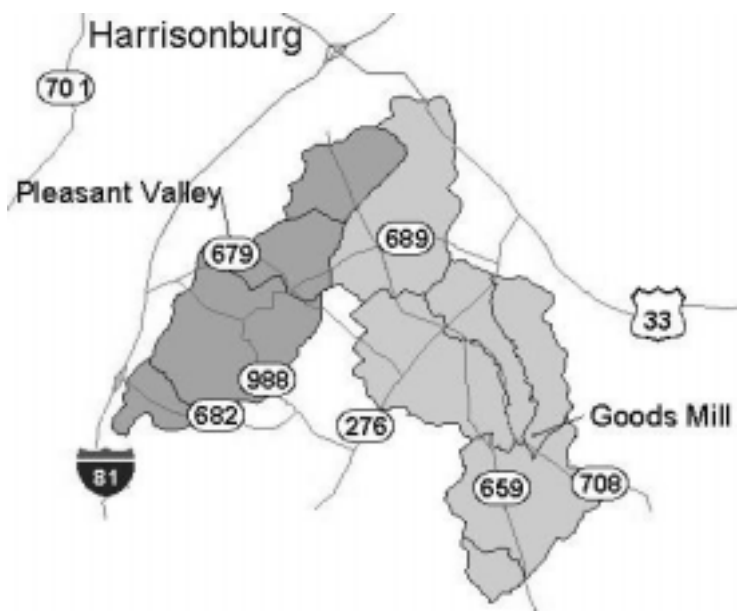
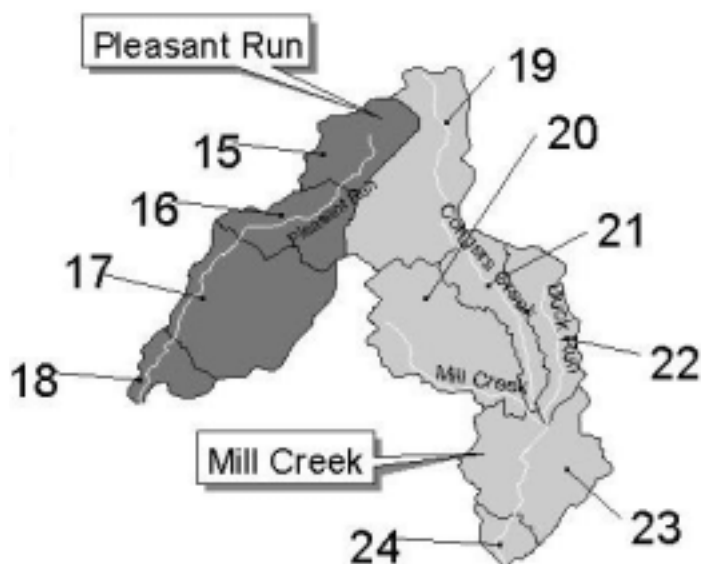
GENERAL: Are sinkholes or caves present on your property? yes no

Do you irrigate? yes no Do you have tile drains? yes no

Which sub-watershed do you live in? Please circle the number on the map located below on the left.

Sub-watershed Map (Please circle the number below)

Road Location Map (for reference only)



Name and Address (optional):

Watershed Survey—Agricultural Areas (Muddy Creek and Lower Dry River)

The **Rockingham County Farm Bureau** requests this information as part of its effort to help the agricultural community meet the total maximum daily load (TMDL) requirements in the Muddy Creek and Lower Dry River watersheds. Although the survey will be anonymous, we do ask that you specify the sub-watershed that your land is in to allow us to accurately target areas where resources might be needed.

Indicate your response with a ☐ or ☐ in appropriate box

FARM SIZE (Include rented acres): 50 Acres or less 51 to 100 acres More than 100 acres
Does a stream run through your property? yes no
TYPE OF OPERATION (Check all that apply): Dairy Beef Poultry Sheep Swine Other

MANAGEMENT PRACTICES

The source(s) of water for my livestock include: Pond Trough Stream Developed Spring Other

Which of the following practices have you implemented since 1997?

Stream fencing	Alternative water	Stormwater control (put a roof over a loafing lot, etc.)
Hardened water crossing	Conservation tillage	Other _____
Grass filter strips	Contour strip-cropping	
Manure storage	Upgraded a septic system	

If none, do you plan on putting in some new practices soon? yes no

NUTRIENT MANAGEMENT

Do you have manure storage? yes no

If yes, what type of storage: Dry Stack Site Dry Stack Structure Liquid Pit or Structure

If yes, what type of waste is being stored? Dairy Beef Poultry Sheep Swine Other

Storage capacity of site/structure: Less than 4 Months 4 - 6 Months More than 6 Months

Do you scrape and haul daily? yes no

Do you currently have a Nutrient Management Plan? yes no

Do you land-apply manure or other biosolids? yes no

If yes, approximately how much do you apply per year? _____ tons/acre or _____ gals/acre

When do you spread (circle all that apply)? Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Did you ever calibrate your manure spreader? yes no

Have you ever had your agricultural manures analyzed for nutrient values? yes no

Do you receive biosolids from elsewhere in the community for land application on your farm? yes no

If yes, how often? _____ **How much each time?** _____ **Where are the biosolids from?** _____

FERTILIZER Type used:

Organic (manure, compost) Inorganic (ammonia, phosphate) Combination = Organic__% and Inorganic__%

DAIRY: Total number of dairy animals: Cows _____ Heifers _____

Number of cows milked: _____

Average size of milk cows: 750-1,000 Lbs. 1,000-1,250 Lbs. 1,250-1,500 Lbs.

POULTRY: Type: Broilers Turkey Hens Turkey Toms Turkey Breeders Broiler Breeders Other

Number of Birds/Flock: _____ **Number of Flocks/Year:** _____

Type of dead bird disposal: Incineration Composting In-Ground Burial Rendering

BEEF: Total number of animals: _____

Type of operation: Cow/calf Feeder calves Finishing

SWINE: Total number of animals: _____

Type of Operation: Farrow to Finish Farrowing Finishing

SHEEP: Total number of animals: _____

Type of Operation: Ewe & Lamb Feeding Finishing Other

HORSES: Total number of animals: _____

OTHER: _____

HUMAN WASTE DISPOSAL

Type of system installed: Septic Sand System Package Treatment System Privy Community Sewer

Number of people served by your system on an average day: 1-2 3-5 6-10 11-20 Over 20

Has the septic tank been pumped within the past 5 years? yes no If not, when? _____

When was the system installed? (if known) _____ **Has it ever failed?** yes no I don't know

GENERAL: Are sinkholes or caves present on your property? yes no

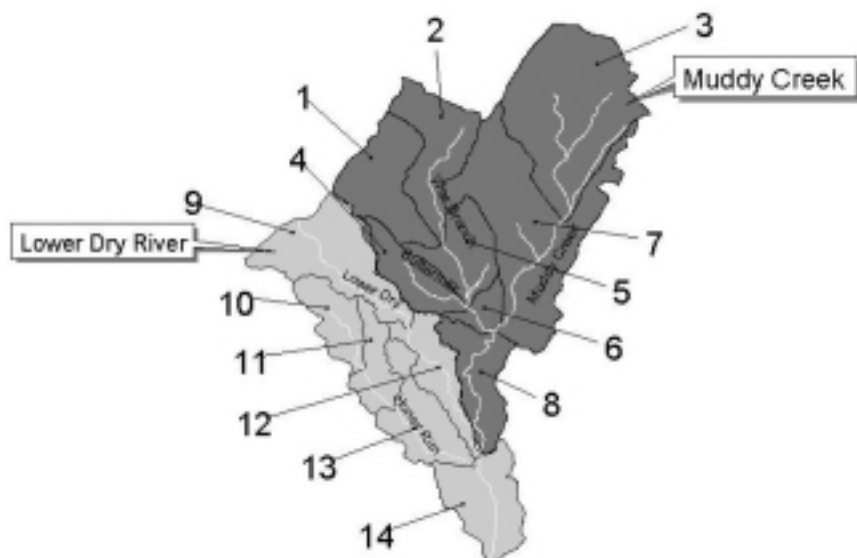
Do you irrigate? yes no **Do you have tile drains?** yes no

Which sub-watershed do you live in? Please circle the number on the map located below on the left.

Sub-watershed Map

(Please circle the number below)

Road Location Map (for reference only)



Name and Address (optional):

APPENDIX B

Descriptions of BMPs

Animal waste management: A planned system designed to manage liquid and solid waste from livestock and poultry. It improves water quality by storing and spreading waste at the proper time, rate and location.

Artificial wetland/rock reed microbial filter: A long shallow hydroponic plant/rock filter system that treats polluted waste and wastewater. It combines horizontal and vertical flow of water through the filter, which is filled with aquatic and semi-aquatic plants and microorganisms and provides a high surface area of support media, such as rocks or crushed stone.

Avoid adding materials containing trace metals: Limiting or eliminating application of fertilizers and pesticides containing trace metals.

Compost facility: Treating organic agricultural wastes in order to reduce the pollution potential to surface and ground water. The composting facility must be constructed, operated and maintained without polluting air and/or water resources.

Conservation landscaping: The placement of vegetation in and around stormwater management BMPs. Its purpose is to help stabilize disturbed areas, enhance the pollutant removal capabilities of a stormwater BMP, and improve the overall aesthetics of a stormwater BMP.

Conservation tillage: Any tillage and planting system that maintains at least 30% of the soil surface covered by residue after planting for the purpose of reducing soil erosion by water.

Contour farming: Tillage, planting, and other farming operations performed on or near the contour of the field slope. This results in reducing sheet and rill erosion and reducing transport of sediment and other water-borne contaminants. This practice applies on sloping land where crops are grown and is most effective on slopes between 2 and 10 percent.

Cover crops and rotations: Establishing grass and/or legume vegetation to reduce soil erosion and enhance water quality.

Critical area planting: Establishing permanent vegetation on sites that have or are expected to have high erosion rates, and on sites that have physical, chemical or biological conditions that prevent the establishment of vegetation with normal practices. This practice is used in areas with existing or expected high rates of erosion or degraded sites that usually cannot be stabilized by ordinary conservation treatment.

Crop rotations: Growing crops in a recurring sequence on the same field in order to: reduce sheet and rill erosion, reduce soil erosion from wind, maintain or improve soil organic matter content, manage the balance of plant nutrients, improve water use efficiency, manage saline seeps, manage plant pests, provide food for domestic livestock, and provide food and cover for wildlife.

Crop/plant variety selection: management strategy (part of Integrated Pest Management) used to control pests (i.e. weeds, insects, diseases) while minimizing pollution. Crop rotation is used to break pest life cycles. Volunteer plants serving as hosts for certain diseases and insects can be controlled by destroying the crop two to three weeks prior to planting new crops.

Detention pond/basin: Detention ponds maintain a permanent pool of water in addition to temporarily detaining stormwater. The permanent pool of water enhances the removal of many pollutants. These ponds fill with stormwater and release most of it over a period of a few days, slowly returning to its normal depth of water.

Diversions: Establishing a channel with a supporting ridge on the lower side constructed along the general land slope which improves water quality by directing nutrient and sediment laden water to sites where it can be used or disposed of safely.

Drip irrigation: An irrigation method that supplies a slow, even application of low-pressure water through polyethylene tubing running from supply line directly to a plant's base. Water soaks into the soil gradually, reducing runoff and evaporation (*i.e.*, salinity). Transmission of nutrients and pathogens spread by splashing water and wet foliage created by overhead sprinkler irrigation is greatly reduced. Weed growth is minimized, thereby reducing herbicide applications. Vegetable farming and virtually every type of landscape situation can benefit from the use of drip irrigation.

Earthen embankment: A raised impounding structure made from compacted soil. It is appropriate for use with infiltration, detention, extended-detention or retention facilities.

Fencing: A constructed barrier to livestock, wildlife or people. Standard or conventional (barbed or smooth wire), suspension, woven wire, or electric fences shall consist of acceptable fencing designs to control the animal(s) or people of concern and meet the intended life of the practice.

Field borders: The establishment of field borders adjacent to wildlife habitats that will soften field transitions to other land uses. These borders can be on any side of a field and are not restricted to lower field borders, as are filter strips.

Filtration (*e.g.*, sand filters): Intermittent sand filters capture, pretreat to remove sediments, store while awaiting treatment, and treat to remove pollutants (by percolation through sand media) the most polluted stormwater from a site. Intermittent sand filter BMPs may be constructed in underground vaults, in paved trenches within or at the perimeter of impervious surfaces, or in either earthen or concrete open basins.

Grade stabilization (*e.g.*, chemical stabilization): A temporary measure employed on bare soils until permanent vegetation is established or other long-term erosion-control measures are implemented. The use of organic chemicals and oil derivatives may not be possible due to suspected surface and ground water contamination by carcinogenic priority organic pollutants.

Grassed swale: A broad and shallow earthen channel vegetated with erosion resistant and flood-tolerant grasses. Check dams are strategically placed in the swale to encourage ponding behind them. The purpose of a grassed swale is to convey stormwater runoff at a non-erosive velocity in order to enhance its water quality through infiltration, sedimentation, and filtration.

Grassed waterway: A natural or constructed channel that is shaped or graded to required dimensions and established with suitable vegetation which conveys runoff from terraces, diversions, or other water concentrations without causing erosion or flooding and reduces gully erosion.

Green rooftops: A thin layer of vegetation that is installed on top of a conventional flat or slightly sloping roof. It can consist of a light weight vegetated system, or an elaborate rooftop landscape or garden. Internal drainage layers serve to moderate the rate of runoff while allowing for water and nutrient uptake by vegetated materials. Green rooftops can often be engineered to conform to existing load requirements of most roofs—therefore enabling the retrofit of existing buildings.

Infiltration Basin: A vegetated open impoundment where incoming stormwater runoff is stored until it gradually infiltrates into the soil strata. While flooding and channel erosion control may be achieved within an infiltration basin, they are primarily used for water quality enhancement.

Infiltration Trench: A shallow, excavated trench backfilled with a coarse stone aggregate to create an underground reservoir. Stormwater runoff diverted into the trench gradually infiltrates into the surrounding soils from the bottom and sides of the trench. The trench can be either an open surface trench or an underground facility.

Integrated pest management: A procedure to prevent excessive and/or unnecessary application of pesticides to land and/or crops for the control of pests. Improves water quality by scouting fields and/or crops and applying pesticides only when the pest reaches the threshold of economic damage.

Irrigation water management: The process of determining and controlling the volume, frequency, and application rate of irrigation water in a planned, efficient manner. An irrigation system adapted for site conditions (soil, slope, crop grown, climate, water quantity and quality, etc.) must be available and capable of applying water to meet the intended purpose(s).

Lagoon pump out: A waste treatment impoundment made by constructing an embankment and/or excavating a pit or dugout in order to biologically treat waste (such as manure and wastewater) and thereby reduce pollution potential by serving as a treatment component of a waste management system.

Land-use conversion: BMPs that involve a change in land use in order to retire land contributing detrimentally to the environment. Some examples of BMPs with associated land use changes are: Conservation Reserve Program (CRP) - cropland to pasture; Forest conservation - pervious urban to forest; Forest/grass buffers - cropland to forest/pasture; Tree planting - cropland/pasture to forest; and Conservation tillage - conventional tillage to conservation tillage.

Limit livestock access: Excluding livestock from areas where grazing or trampling will cause erosion of stream banks and lowering of water quality by livestock activity in or adjacent to the water. Limitation is generally accomplished by permanent or temporary fencing. In addition, installation of an alternative water source away from the stream has been shown to reduce livestock access.

Litter control: Litter includes larger items and particulates deposited on street surfaces, such as paper, vegetation residues, animal feces, bottles and broken glass, plastics and fallen leaves. Litter-control programs can reduce the amount of deposition of pollutants by as much as 50%, and may be an effective measure of controlling pollution by storm runoff.

Livestock water crossing facility: Providing a controlled crossing for livestock and/or farm machinery in order to prevent streambed erosion and reduce sediment.

Manufactured BMP systems: Structural measures which are specifically designed and sized by the manufacturer to intercept stormwater runoff and prevent the transfer of pollutants downstream. They are used solely for water quality enhancement in urban and ultra-urban areas where surface BMPs are not feasible.

Mulching/protective covers: Applying plant residues, by-products or other suitable materials produced off site, to the land surface. This practice conserves soil moisture, moderates soil temperature, provides erosion control, suppresses weed growth, establishes vegetative cover, improves soil condition, and increases soil fertility.

Nutrient management: Determining nutrient needs for cropland (with the exception of hay or pasture that receives mechanical applications of collected animal manure) and adjusting the application of nutrients accordingly.

Onsite treatment system installation: Conventional onsite wastewater treatment and disposal system (onsite system) consists of three major components: a septic tank, a distribution box, and a subsurface soil absorption field (consisting of individual trenches). This system relies on gravity to carry household waste to the septic tank, move effluent from the septic tank to the distribution box, and distribute effluent from the distribution box throughout the subsurface soil absorption field. All of these components are essential for a conventional onsite system to function in an acceptable manner.

Porous pavement: An alternative to conventional pavement, it is made from asphalt (in which fine filler fractions are missing) or modular or poured-in concrete pavements. Its use allows rainfall to percolate through it to the subbase, providing storage and enhancing soil infiltration that can be used to reduce runoff and combined sewer overflows. The water stored in the subbase then gradually infiltrates the subsoil.

Proper site selection for animal feeding facility: Establishing or relocating confined feeding facilities away from environmentally vulnerable areas such as sinkholes, streams, and rivers in order to reduce or eliminate the amount of pollutant runoff reaching these areas.

Rain garden: Rain gardens are landscaped gardens of trees, shrubs, and plants located in commercial or residential areas in order to treat stormwater runoff through temporary collection of the water before infiltration. They are slightly depressed areas into which stormwater runoff is channeled by pipes, curb openings, or gravity.

Range and pasture management: Systems of practices to protect the vegetative cover on improved pasture and native rangelands. It includes practices such as seeding or reseeded, brush management (mechanical, chemical, physical, or biological), proper stocking rates and proper grazing use, and deferred rotational systems.

Re-mining: Surface mining of previously mined and abandoned surface and underground mines to obtain remaining coal reserves. Re-mining operations create jobs in the coal industry, produce coal from previously disturbed areas, and improve aesthetics by backfilling and re-vegetating areas according to current reclamation standards. Re-mining operations also reduce safety and environmental hazards (by sealing existing portals and removing abandoned facilities), enhance land use quality, and decrease pre-existing pollution discharges.

Retention basin: A stormwater facility that includes a permanent pool of water and, therefore, is normally wet even during non-rainfall periods. Inflows from stormwater runoff may be temporarily stored above this permanent pool.

Riparian Buffer Zone: A protection method used along streams to reduce erosion, sedimentation, and the pollution of water from agricultural nonpoint sources.

Roof down-spout system: A structure that collects, controls, and transports precipitation from roofs. This practice may be applied as a part of a resource management system in order to improve water quality, reduce soil erosion, increase infiltration, protect structures, and increase water quantity.

Septic system pump-out: A typical septic system consists of a tank that receives waste from a residence or business, and a drain field or subsurface absorption system consisting of a series of percolation lines for the disposal of the liquid effluent. Solids (sludge) that remain after decomposition by bacteria in the tank must be pumped out periodically.

Sewer line maintenance/sewer flushing: Sewer flushing during dry weather is designed to periodically remove solids that have deposited on the bottom of the sewer and the biological slime that grows on the walls of combined sewers during periods of low-flow. Flushing is especially necessary in sewer systems that have low grades which has resulted in velocities during low-flow periods that fall below those needed for self-cleaning.

Silt Fencing: A temporary sediment barrier consisting of filter fabric buried at the bottom, stretched, and supported by posts, or straw bales staked into the ground, designed to retain sediment from small disturbed areas by reducing the velocity of sheet flows. Because silt fences and straw bales can cause temporary ponding, sufficient storage area and overflow outlets should be provided.

Spillway, emergency: A vegetated emergency spillway is an open channel, usually trapezoidal in cross-section, which is constructed beside an embankment. It consists of an inlet channel, a control section, and an exit channel, and is lined with erosion-resistant vegetation. Its purpose is to convey flows that are greater than the principal spillway's design discharge at a non-erosive velocity to an adequate channel.

Spillway, principal: The primary outlet device for a stormwater impoundment usually consisting of either a riser structure in combination with an outlet conduit (which extends through the embankment) or a weir control section cut through the embankment. The purpose of a principal spillway is to provide a primary outlet for storm flows, usually up to the 10- or 25-year frequency storm event. The principal spillway is designed and sized to regulate the allowable discharge from the impoundment facility.

Stream bank protection and stabilization: Stabilizing shoreline areas that are being eroded by landshaping, constructing bulkheads, riprap revetments, gabion systems, or establishing vegetation.

Street sweeping: The practice of passing over an impervious surface, usually a street or a parking lot, with a vacuum or a rotating brush for the purpose of collecting and disposing of accumulated debris, litter, sand, and sediments. In areas with defined wet and dry seasons, sweeping prior to the wet season is likely to be beneficial; following snowmelt and heavy leaf fall are also opportune times.

Strip cropping: Growing row crops, forages, small grains, or fallow in a systematic arrangement of equal width strips across a field that reduces soil erosion and protects growing crops from damage by wind-borne soil particles.

Terraces: An earth embankment, or a combination ridge and channel, constructed across the field slope. Terraces can be used when there is a need to conserve water, excessive runoff is a problem, and the soils and topography are such that terraces can be constructed and farmed with reasonable effort.

Vegetated filter strip: A densely vegetated strip of land engineered to accept runoff from upstream development as overland sheet flow. It may adopt any naturally vegetated form, from grassy meadow to small forest. The purpose of a vegetated filter strip is to enhance the quality of stormwater runoff through filtration, sediment deposition, infiltration and absorption.

Waste system/storage (e.g., lagoons, litter shed): Waste treatment lagoons biologically treat liquid waste to reduce the nutrient and BOD content. Lagoons must be emptied and their contents disposed of properly.

Water treatment: Physical, chemical and/or biological processes used to treat concentrated discharges. Physical-chemical processes that have been demonstrated to effectively treat discharge include sedimentation, vortex separation, screening (e.g., fine-mesh screening), and sand-peat filters. Chemical additives used to enhance separation of particles from liquid include chemical coagulants such as lime, alum, ferric chloride, and

various polyelectrolytes. Biological processes that have been demonstrated to effectively treat discharges include contact stabilization, biodiscs, oxidation ponds, aerated lagoons, and facultative lagoons.

Wetland development/enhancement: The construction of a wetland for the treatment of animal waste runoff or stormwater runoff. Wetlands improve water quality by removing nutrients from animal waste or sediments and nutrients from stormwater runoff.

APPENDIX C

BMP Tracking Tools

[illegible]

Figure C-1 Sample government form obtained from DCR

	A	B	C	D	E	F	G	H	I	J	K	L	M
1					SUMMARY DATA FOR NORTH CREEK IMPLEMENTATION PLAN								
2													
3													
4	Participant		Tract		BMP	Unit	Number	Cost	Funding	Funding	Date of	Projected	Date
5			Number			Measure	of Units	per Unit	\$	Source	Funding	Completion	Completed
6													
7	James Doe		SW-51877		Fencing	lin. ft.	595	\$1.78	\$1,059.10	VADCR	Jan-00	Dec-01	May-02
8	James Doe		SW-51877		Livestock Crossing	lin. ft.	8	\$27.40	\$219.20	EPA 319	Jun-00	Sep-00	Sep-00
9													
10	Joan Jones		NW-5300		Vegetated Filter Strip	acre	3	\$99.00	\$297.00	EQIP	Apr-02	Dec-01	Nov-01
11													
12	Peter Smith		NE-28339		Fencing	lin. ft.	375	\$1.78	\$667.50	VADCR	Jan-00	Dec-01	Aug-01
13													
14													
15													
16													
17													
18													
19													
20													
21													
22	Total								\$2,242.80				
23													

Figure C-2 Sample spreadsheet for summarizing implementation actions

C-4

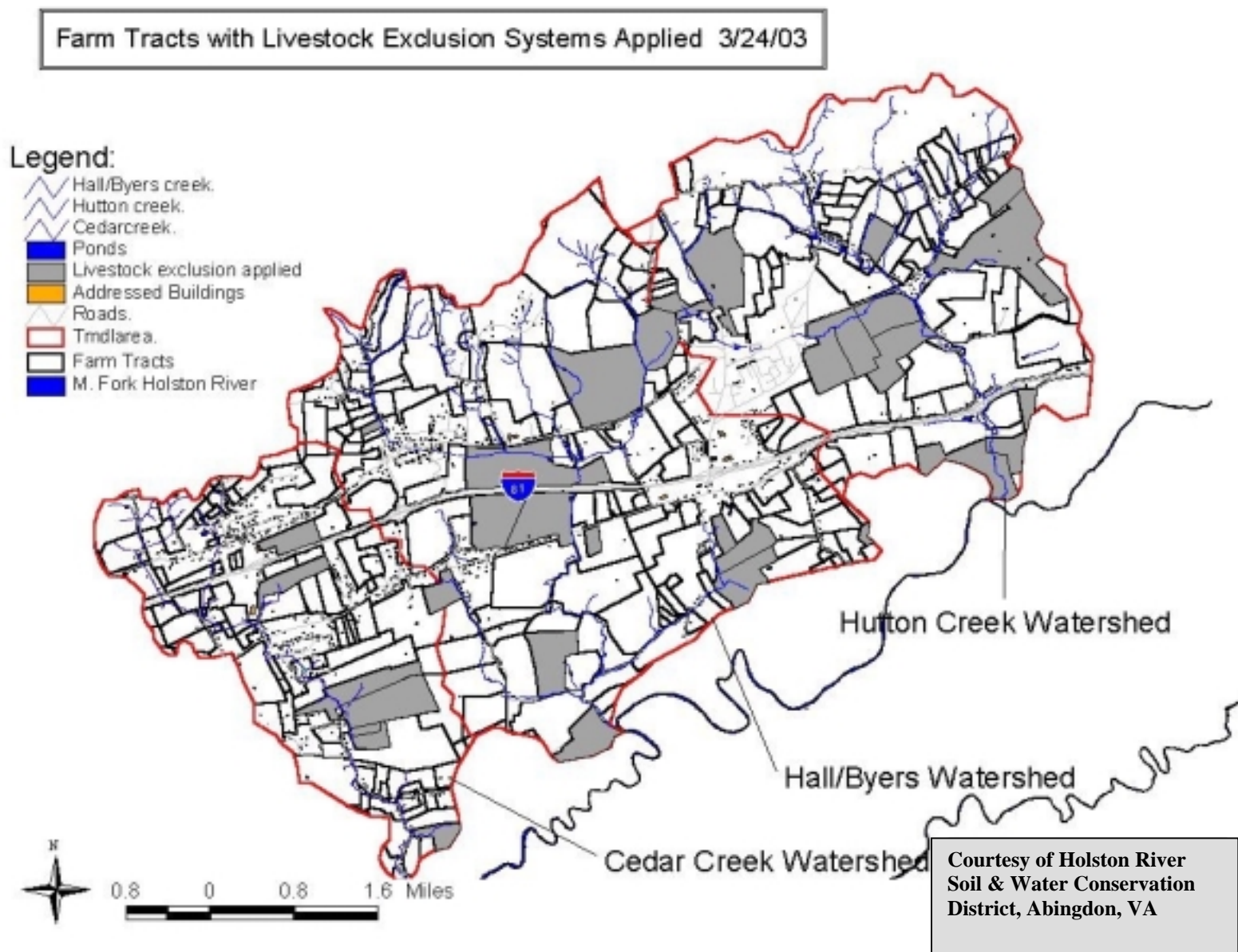


Figure C-3 GIS layering used for summarizing implementation actions

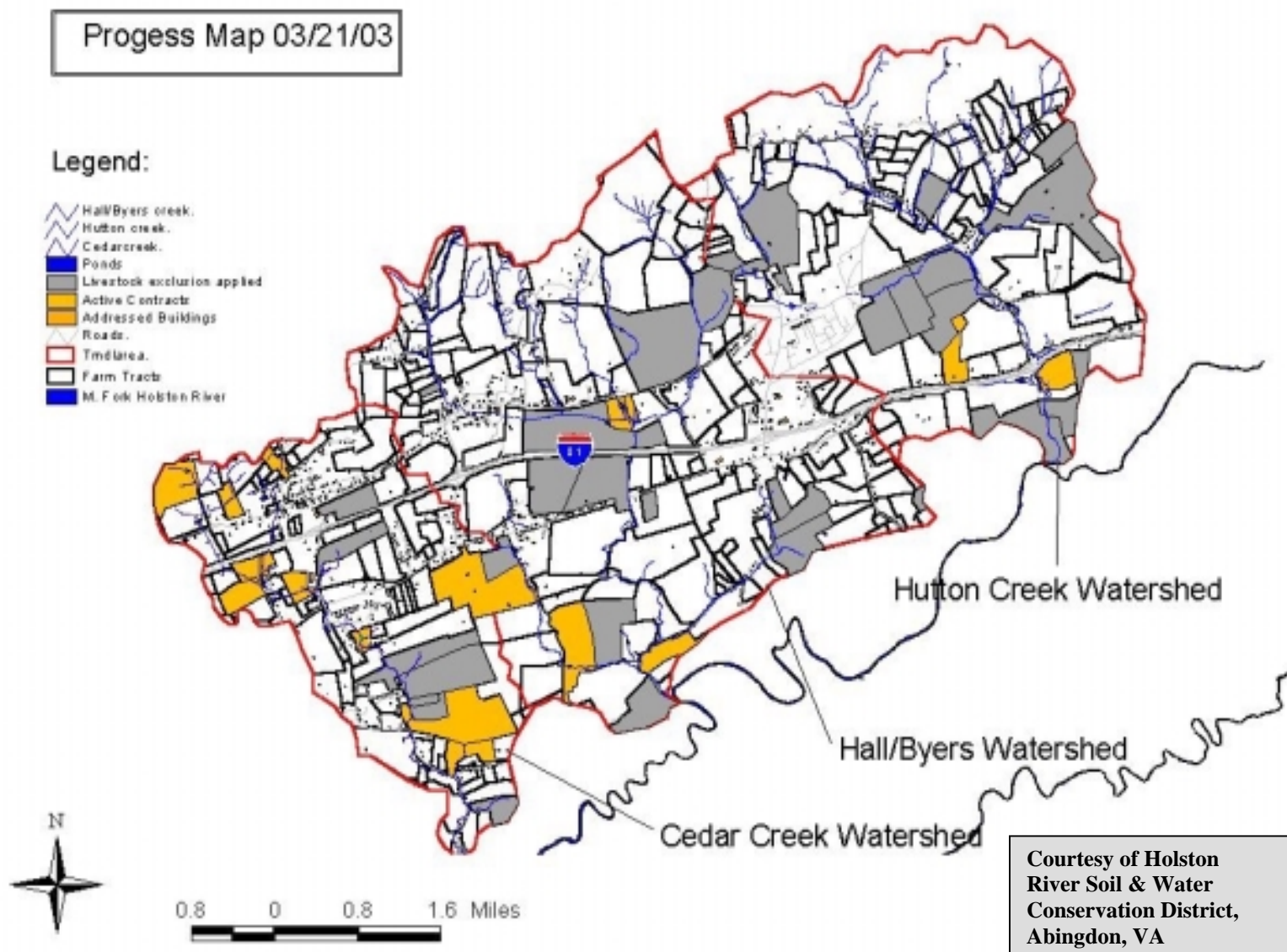


Figure C-4 GIS layering used for summarizing implementation actions